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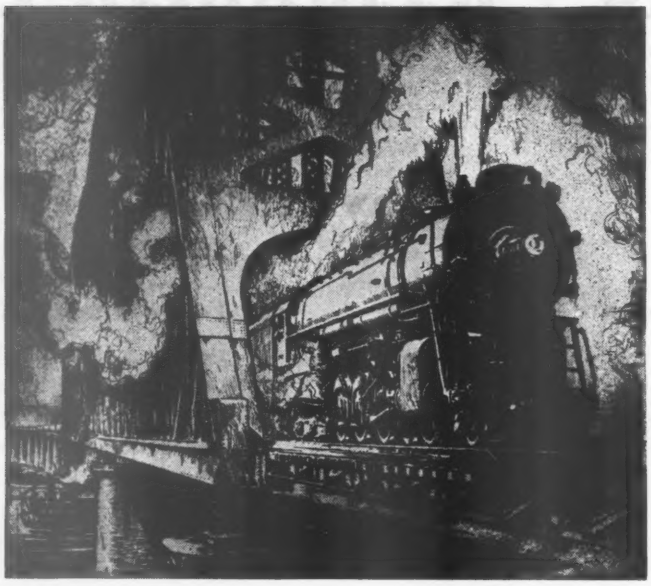

WHAT MODERN LOCOMOTIVES

mean

TO FUEL ECONOMY

"The development of fuel economy can be seen in the following illustration of typical freight engines of 10 and 20 years ago, compared with typical engines of today:

	1912	1922	1932
Fuel economy	6½ lbs. coal per drawbar horsepower	5 lbs. coal per drawbar horsepower	3 lbs. or less coal consumption per drawbar horsepower hour

—*Wall Street Journal, February 24, 1933*

With 83% of the locomotives on Class 1 roads today more than 10 years old, the greater economy resulting from full use of modern motive power is obvious.

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Railway
Mechanical Engineer

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May - 1933

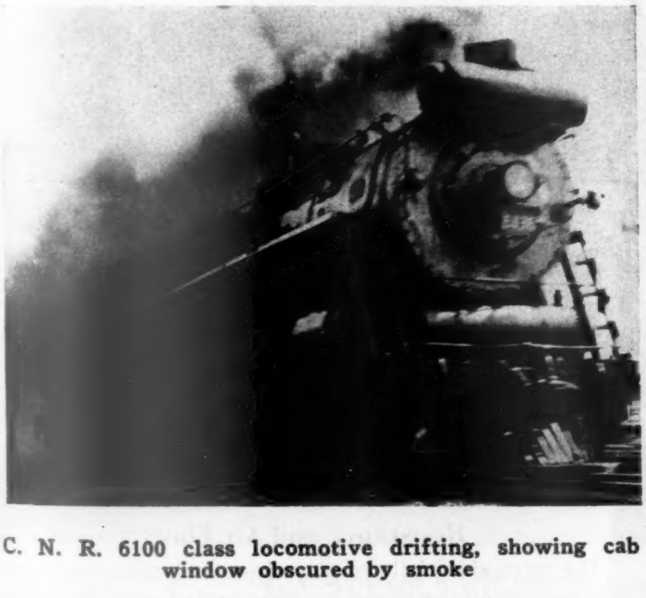
Wind Tunnel Tests of Locomotive Streamlining[1]

Part I

By J. J. Green[2]

The paper describes work done in the wind tunnel of the National Research Laboratories, Ottawa, Canada and discusses the steps whereby an improved external shape has been evolved for locomotives such that the smoke is lifted over the cab thus making possible an unimpaired vision ahead. By removing the violent eddying flow about the locomotive the air resistance of the engine and tender has been reduced to the extent of some 35 per cent.

IT is an unfortunate feature of the steam locomotive in its present state that the exhaust steam and smoke have to be emitted at a position some distance ahead of the cab. With the development of higher-powered locomotives, the shorter stacks have increased the problem of lifting the smoke clear of the cab. When the locomotive is drifting, the absence of the exhaust steam jet in the stack allows the smoke to pour down over the top and



C. N. R. 6100 class locomotive drifting, showing cab window obscured by smoke

sides of the boiler, seriously impairing vision from the cab windows. If it is possible to lift the smoke well clear of the cab, it is quite likely that it will remain above the train so that the quantity of smoke and cinders entering the coaches will be reduced. No recent scheme for curing this trouble has been sufficiently successful to merit general adoption. A number of odd-shaped devices have been attached to the front of the boiler and the stack, but their lack of success is due to the fact that the aerodynamics of the entire locomotive is involved, particularly the front and upper surface of the boiler. The Canadian National Railways and a number of other roads have experimented with deflectors at the stack, but they have not given satisfaction.

In these investigations it was hoped that radical changes in the entire locomotive shape would yield considerable improvement in smoke flow and resistance. It was felt that the use of side guards was an attempt to improve slightly what is already a very poor aerodynamic shape. Wind tunnel tests substantiate the statement that

[1] An abstract of a paper printed in the January, 1933, issue of the Canadian Journal of Research.
[2] Junior research physicist, National Research Laboratories, Ottawa, Canada.

the entire upper surface of a modern locomotive is shrouded in eddies due to poor aerodynamic design. These eddies behind the stack, dome and valves trap the smoke which is then comparatively slowly dissipated since the eddies reduce considerably the average air velocity over the boiler. This retarding of the flow adjacent to the boiler is further enhanced by the crude shape of the boiler front. Removal of the smoke nuisance by changes in design which will give smooth high speed air flow over the boiler top and sides will obviously produce at the same time a reduction of the air resistance of the locomotive, and in recent times the reduction of running costs by minimizing air resistance has been slowly coming to the forefront. Work at the National Physical Laboratory for the L. M. S. and L. N. E. R. railways[3], and that of Tietjens[4], [5], may be cited as being typical of the attention being devoted to air resistance.

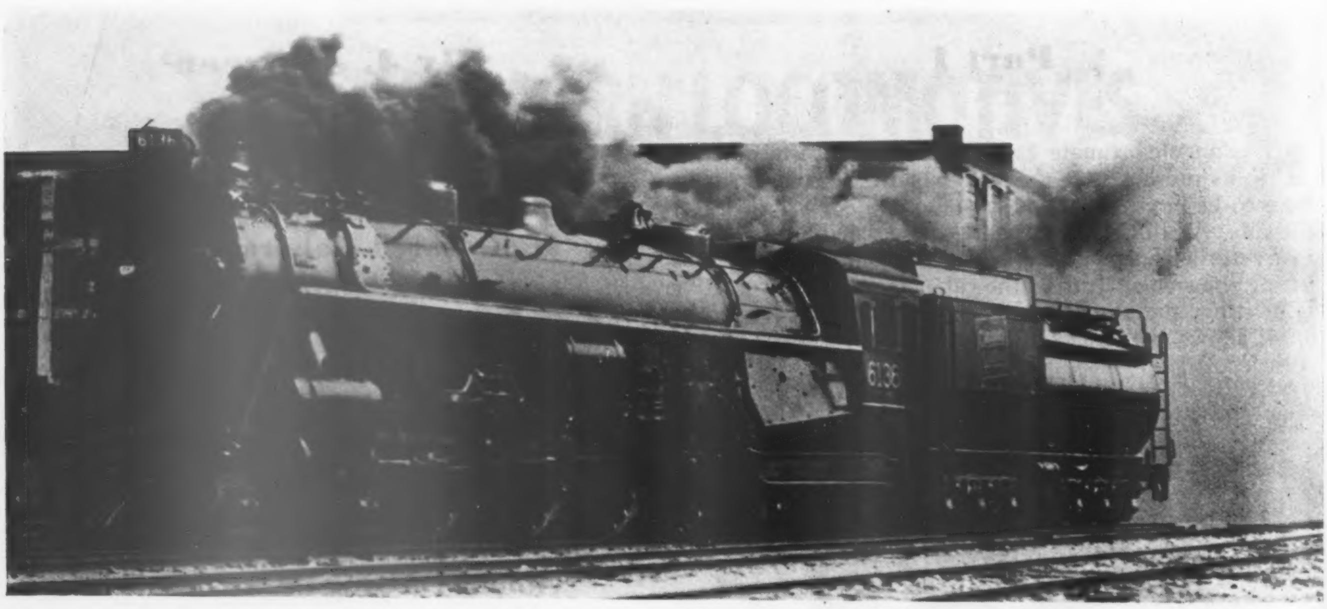
Air resistance at low or medium speeds is small in comparison with other sources of resistance and the locomotive itself has only about 30% of the total air resistance of the train. Since, however, the air resistance increases as the square of the speed, whereas other resistances rise only as some power of the speed less than unity, it is evident that, for the high speed passenger services nowadays common to railroad practice, air-resistance reduction merits attention in the quest for economy.

Scope of the Tests

In 1931 the Canadian National requested the National Research Council to undertake an investigation with a view to improving high-speed locomotive design. A 1/12-scale model of the 6100 class engine and tender, complete in every detail and constructed mainly of steel, was forwarded for use in the wind tunnel tests. The open tunnel with a jet 9 ft. in diameter, 13 ft. long and a maximum speed of 160 m.p.h. was eminently suitable for the work to be done.

A number of restrictions were imposed on the work at the outset; for example, owing to legal restrictions, certain features such as a bell, whistle, stairways at front and runways at sides cannot be eliminated, although their disposition might be changed. Further restrictions arose from the fact that the same general shape, sizes and clearances and operating arrangements were to be retained, and that definite accessibility for connecting rods, valve motion, axles and axle boxes was required. Despite the great saving in air resistance, no cowling could be tolerated over this mechanism, and the firebox had to be left free to prevent blocking of the air-opening into the ash pan. Other structural limitations were imposed by the restricted position and height above the water level in the boiler of the feed-water heater. Clearance for the water supply pipes also limited the level of the top of the water tank. Finally all modifications were to be such as could be done economically and easily, with the bare minimum of alteration to the locomotive itself, and this practical aspect has been kept in mind throughout the work.

In view of the difficulty of extensive alteration to the scale model supplied, without damaging it, a wooden model was made to the same dimensions, reproducing all the main essentials, without the minor details. Both models were tested for resistance, and the ground effect on the steel model was measured with a dummy ground utilizing the wooden model as a mirror image.



C. N. R. 6100 class locomotive drifting, showing poor flow of smoke

The wind speeds employed in the tests ranged up to 170 ft. per sec., and above speeds of 30 or 40 ft. per sec. no scale effect existed, that is, the resistance coefficient obtained by dividing the resistance by the square of the wind speed is a constant within the limits of practical measurement. This linear variation of resistance with the square of the speed allows prediction of the full-scale locomotive resistance with greater assurance of accuracy.

Resistance and Air Flow

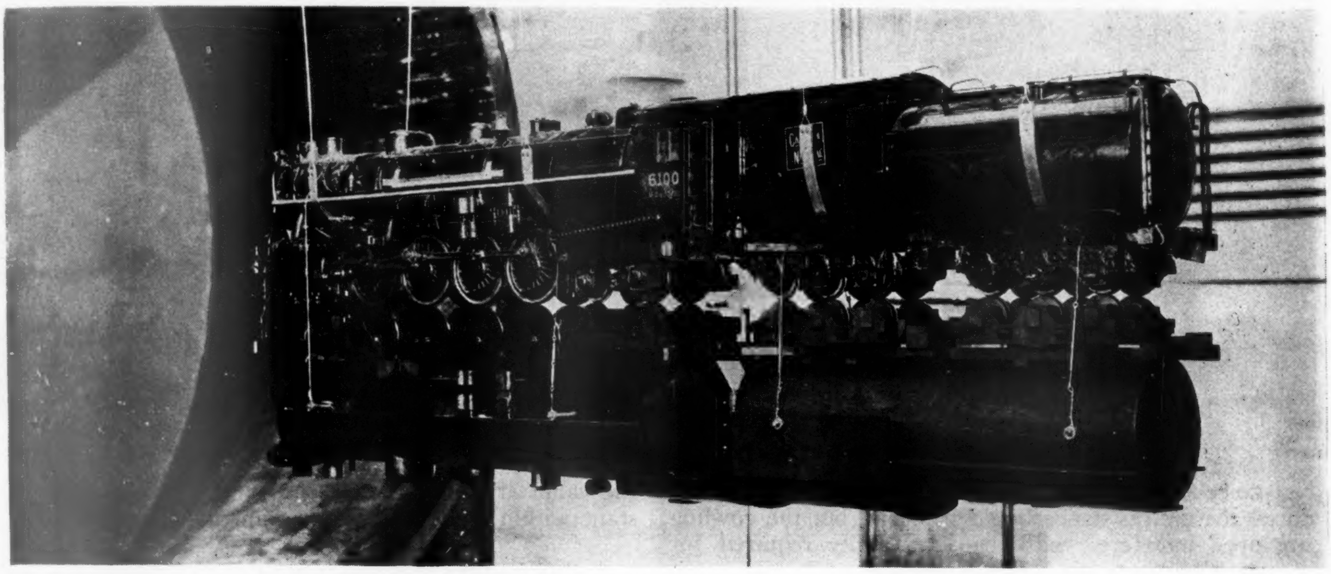
The method initially employed for measuring resistance was to suspend the model by wires and observe its "swayback" in the wind, computing the resistance from the observations. The drawbacks to this method were that the model oscillated considerably rendering observation difficult, the computations were laborious, and in the case of the wooden model it was necessary to load it with lead weights to limit the "swayback," which increased the number of wires in the jet and complicated the oscillation of the model.

In view of these objections, a rough subframe drag

[3] HARTLEY, SIR H. Research on the L. M. S. railway. Engineer, 153:611. 1932.
[4] TIETJENS, O. G. Air resistance of trains. Westinghouse Research Department Report R-7408-A. 1930.
[5] TIETJENS, O. G., and RIPLEY, K. C. Air resistance of interurban cars. Westinghouse Research Department Report R-7408-B. 1931.

balance was built above the jet. The force on the model was transmitted by suspension and bracing wires to the subframe and thence to the scale pan of an accurate balance. Ground effec. was supplied by a dummy ground beneath the model, just clear of the wheels.

The velocity vectors of air currents around the model, with its various modifications, were studied by means of silk streamers attached to a grid of very fine wire suspended just above the locomotive, and another just in front of the model. Additional threads were attached along the boiler sides and in front of the cab window. These threads proved very sensitive to changes in shape of the locomotive and were satisfactory in indicating the beneficial effect or otherwise of any specific modification, and in addition they were easily photographed for purposes of recording the air currents existing around the body of the model.



Model of C. N. R. 6100 class locomotive and tender (1/12 scale) suspended in wind tunnel jet with wooden dummy to give ground effect

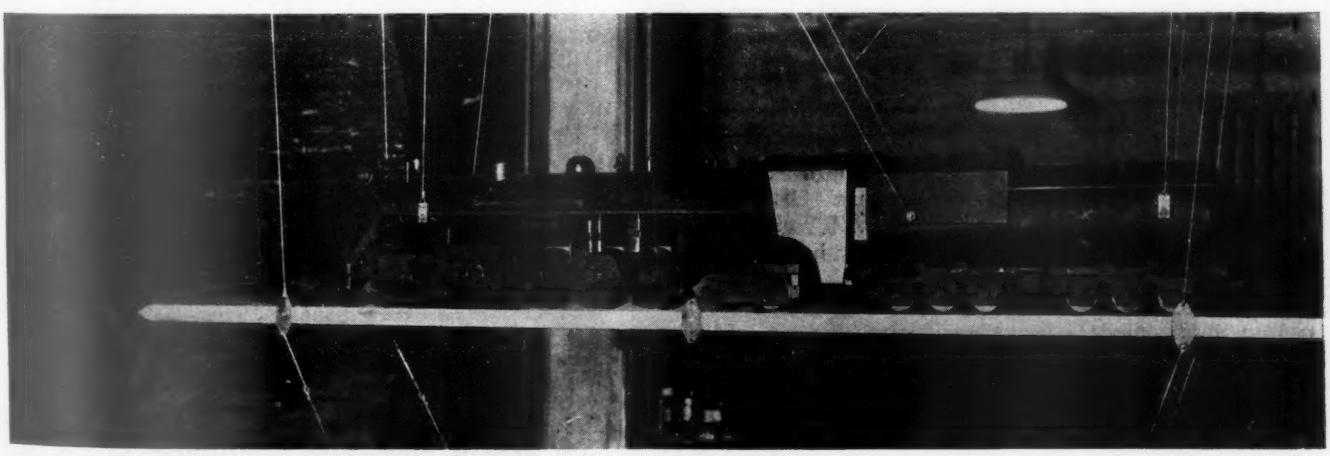


Fig. 1—Wooden model with dummy ground suspended in wind tunnel

All tests were done at zero yaw since the effect of side wind on a high-speed locomotive is considered to be small, in so far as air resistance is concerned, and the results of the work were to be applied to high-speed runs at maximum speeds in the neighborhood of 80 m.p.h. Very litt e room exists for improving the aerodynamic characteristics of railway coaches and since the air is excessively turbulent by the time the last coach is reached, it is doubtful if a special streamlined observation car at the rear end would be worthy of consideration. For these reasons and also because of the predominating importance of the smoke problem, no work was done on reducing train resistance.

The silk threads indicated the exceptionally poor airflow round the existing type of locomotive and showed how the general flow is deflected downwards all along the boiler sides. The existing shape of cab causes the air to pour down in front of the cab windows, and leaves no doubt as to the likelihood of their being obscured when the locomotive is drifting.

General Outline of Results

By progressive steps there has been developed for the locomotive an improved shape which operates primarily by inducing a layer of pure air to enter under the smoke layer, such that a space enveloping the boiler and extending well above the top of the boiler is fed continuously with air uncontaminated by smoke. The construction of the model is such that this smoke-free layer is retained beneath the smoke with a minimum of intermingling of the two. Smooth entry for this c ean air is effected by a new design for the locomotive front end. At the position of the cab further quantities of smoke-free air are induced upward in front of the cab windows, to augment the layer of pure air im-

mediately above the locomotive. Here originally existed a downward current of smoke which necessitated the provision of a grating on the running board in front of the cab window, to allow for the disposal of the cinders collecting there.

The modifications to effect this change of flow result in a reduction of approximately 35 per cent of the air resistance of the locomotive. The best model tested reduced the air resistance by 43 per cent, but the cowling employed interfered with the accessibility required for the working parts.

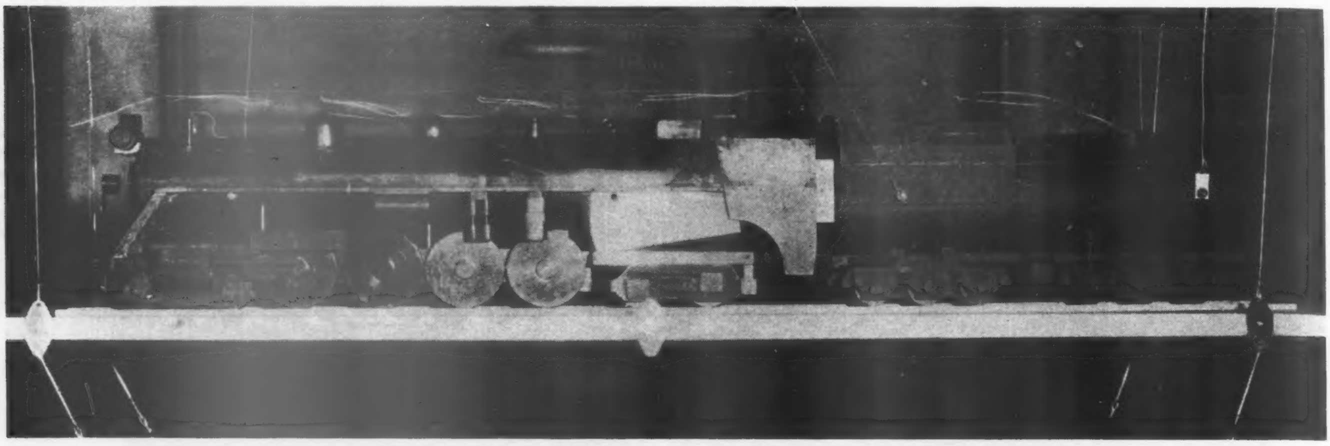


Fig. 2—Air flow over unmodified model as indicated by silk threads—Wind speed, 45 m. p. h.

Description of Tests and Results

Preliminary measurements of wind resistance were made with the $\frac{1}{12}$-scale model. It was suspended at the centre of the wind tunnel jet by means of eight wires (four 12-gauge wires to the locomotive, and four 16-gauge wires to the tender) attached at their lower ends to steel stirrups passing under the boiler and water tank of the model. The upper ends of the wires were fastened to steel I-beams on the platform above the jet. The wires were all identical in length and were arranged to be vertical. The ends of the wires at the model as well as at their upper attachments were pin-jointed. A steel scale graduated in hundredths of an inch was fastened horizontally on the side of the boiler. This steel scale was observed through a telescope set up at the side of the jet, and for each wind speed employed the "sway-back" of the model was observed through the telescope.

The method used for computing wind resistance can be followed by reference to Fig. 3. Let AB represent the model suspended by parallel wires of equal length, OA, PB, in a wind whose direction is indicated by the arrow. Suppose the model sways back to a position $A'B'$. Equilibrium of the system is determined by the weight of the model, the air resistance or drag, and the tension in the supporting wires. $OA'C$ is the triangle of forces where the length OC is proportional to the total model weight W, and the length $A'C$ is proportional to the resistance R. ($OA = OA' = PB$ = length of supporting wires measured from pin joints at each end.)

Let $D = A'C$ the amount by which the model has swayed back.

Then $OC = \sqrt{(OA')^2 - D^2} = \sqrt{(OA' + D)\ (OA' - D)}$.

Now $\frac{R}{W} = \frac{A'C}{OC}$, or $R = \left(\frac{D}{OC}\right) \times W = \frac{D}{\sqrt{(OA + D)\ (OA - D)}} \times W.$

Knowing W and OA and measuring D, it is possible to calculate R, the wind resistance.

Table I gives the results for the metal model for which the total weight, W, was 318.75 lb. The overall length of the suspension wires was 11 ft. 11⅜ in.

The resistance coefficient in the last column includes the air drag of the supporting wires. The existence of scale effect is seen at speeds below about 40 ft. per sec. where the value of $\frac{R}{V^2}$ changes with V. Above this speed the value of the resistance coefficient is reasonably constant within the limits of experimental accuracy.

Assuming then that the resistance coefficient $\frac{R}{V^2} \times 100$ is the same for full scale as at the higher speeds in the model tests, the full-scale resistance at any wind speed V ft. per sec. is derived by multiplying the value of $\frac{R}{V^2}$ by $V^2 \times \left\{\frac{1}{\text{model scale}}\right\}^2$, so that for a $\frac{1}{12}$-scale model the multiplying factor will be $(V^2 \times 144)$, the relative resistances of model and full scale being in the ratio of their frontal areas.

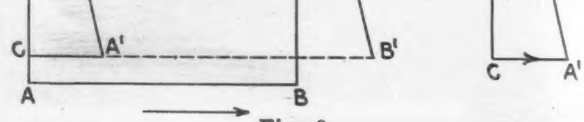


Fig. 3

The reaction at the locomotive due to the wire-suspension drag is given as a contribution to the total resistance measured in the tests, and must therefore be deducted in order to evaluate the resistance of the locomotive and tender alone. Since the curve relating to the resistance of wires, their diameters and wind speed is well known, the value of the resistance of those lengths of the suspension wires included by the air jet was easily calculated for each wind speed used in the tests, and the necessary correction applied.

This gave a mean value of $\frac{R}{V^2} \times 100 = 0.1135$ for the

model alone over the range of speeds for which the coefficient is constant, R being in lb. and V in ft. per sec.

Ground Effect

The resistance measurements on the metal model were not as yet applicable to actual practice in view of the fact that the model had been freely suspended, and the presence of the ground in full scale had not been allowed for.

Two methods suggested themselves for introducing ground effect. It is well known that the effect of a boundary surface on the air flow past a body in its neighborhood is the same as if the boundary was replaced by a second model so placed with respect to the first as to constitute a "mirror image" of the first model in the boundary. The wooden model was then used in the first method for determining ground effect. Knowing the resistance of the metal model freely suspended and subsequently measuring the resistance of the wooden model freely suspended, the sum of these two resistances exceeds the resistance of the combined pair by an amount which represented the effect of the ground. Assuming this effect to work equally on both models, half the effect gives the individual ground interference on any one model.

Table I — Results Obtained With The Metal Model

Wind speed, V, ft. per sec.	Amount of swayback, D, in.	$\sqrt{(OA+D)\ (OA-D)}$	Wind resistance, R, lb.	Coefficient $\frac{R}{V^2} \times 100$
20	0.24	143.375	0.534	0.133
30	0.55	143.374	1.223	.136
40	1.00	143.372	2.223	.139
50	1.56	143.366	3.468	.139
60	2.28	143.357	5.070	.141
70.4	3.12	143.341	6.938	.140
79.8	4.01	143.319	8.918	.140
90	5.14	143.283	11.434	.141
100	6.38	143.233	14.198	.142
110.5	7.77	143.164	17.300	.142
120	9.14	143.084	20.361	.141
154	15.12	142.575	33.750	.142
170.2	18.08	142.230	40.455	.140

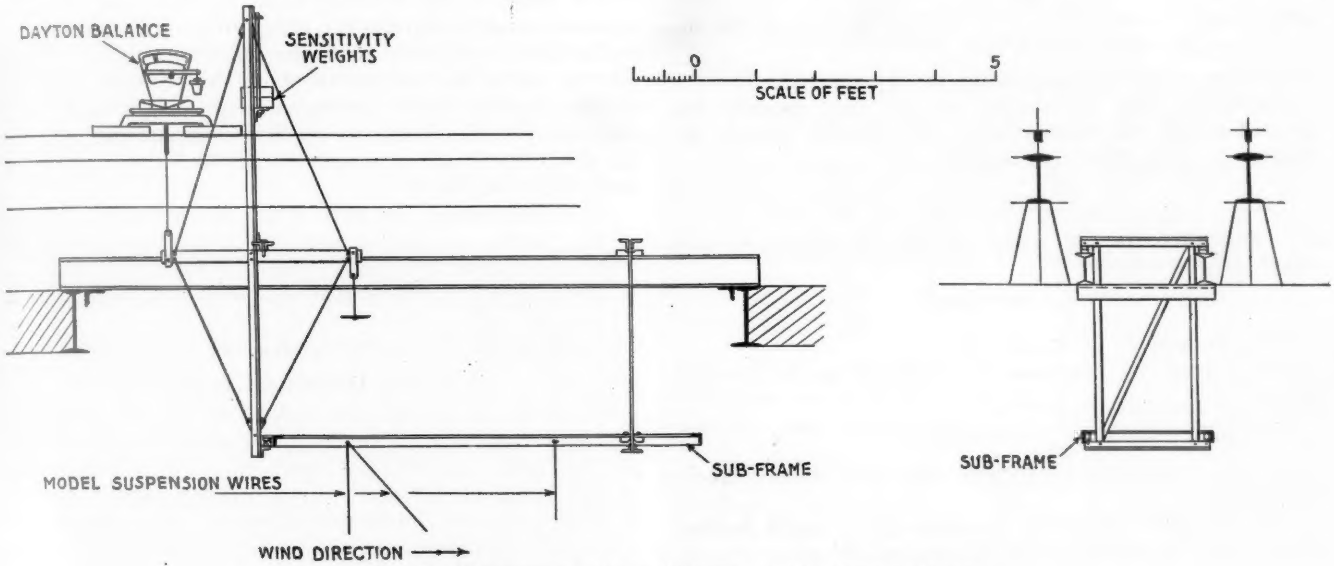


Fig. 4—Diagram of the subframe of the drag balance

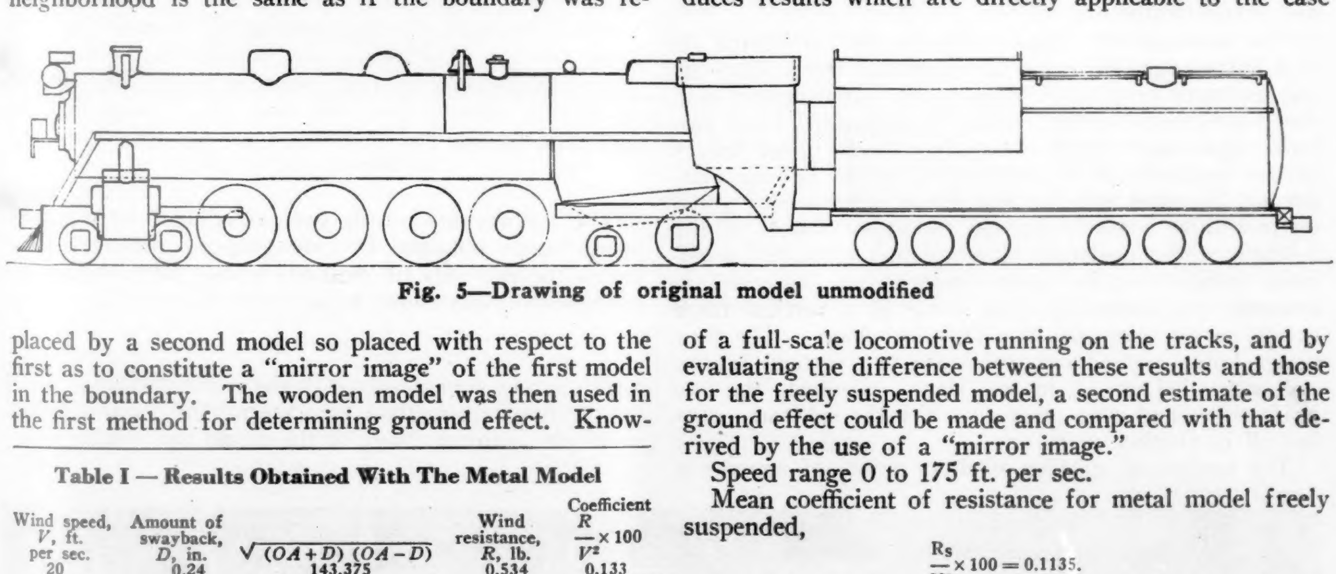


Fig. 5—Drawing of original model unmodified

It was found that the ground effect was such as to reduce the resistance of the locomotive and this becomes obvious when it is considered that the action of the ground is such as to retard the air passing underneath the model.

The second method of evaluating ground effect was to suspend a dummy ground underneath the model, just clear of the wheels, and to measure the resistance of the model with this ground in place. Such a method produces results which are directly applicable to the case of a full-scale locomotive running on the tracks, and by evaluating the difference between these results and those for the freely suspended model, a second estimate of the ground effect could be made and compared with that derived by the use of a "mirror image."

Speed range 0 to 175 ft. per sec.

Mean coefficient of resistance for metal model freely suspended,

$$\frac{R_S}{V^2} \times 100 = 0.1135.$$

Mean coefficient of resistance for wooden model freely suspended,

$$\frac{R_W}{V^2} \times 100 = 0.1062.$$

Mean coefficient of resistance for combined pair freely suspended,

$$\frac{R_S + R_W - 2d}{V^2} \times 100 = 0.2054,$$

where d is the interference effect on each model due to the ground. By addition a set of values for $\frac{R_s + R_w}{V^2} \times 100$ over the speed range are calculated and by

subtracting the corresponding values of $\frac{R_s + R_w - 2d}{V^2}$ a set of values for $\frac{2d}{V^2} \times 100$ are derived. The results gave a mean value for $\frac{d}{V^2} \times 100$ of 0.0067, as the interference effect on each model due to ground.

Correcting the resistances of the two models for ground effect, the resistance of the wooden model, including ground effect, is given by

$$\frac{R}{V^2} \times 100 = 0.0995,$$

the resistance of the metal model, including ground effect, is given by

$$\frac{R}{V^2} \times 100 = 0.1068,$$

R in lb. and V in ft. per sec.

These values are obtained by subtracting the ground effect,

$$\frac{d}{V^2} \times 100 = 0.0067,$$

from the resistance coefficient for each model freely suspended.

The full-scale locomotive resistance at V m.p.h. is then given from the results with the steel model as

$$R = \frac{0.1068}{100} \times \frac{88^2}{60^2} \times 144 \ V^2 \text{ lb.},$$
$$R = 0.3308 \ V^2 \text{ lb.}$$

Measurements with a Subframe Drag Balance

Fig. 4 shows the general arrangement of this drag balance. The subframe is constructed of angle iron welded together, and is suspended from two vertical frames which will be designated by the terms upstream and downstream.

The downstream frame supports the subframe on two knife edges, whereas the upstream frame supports the subframe on a single cone pivot. At its upper end, the downstream vertical frame is suspended from two knife edges, the V-blocks being fixed on the upper flanges of two longitudinal I-beams resting on the balance platform. The upstream vertical frame is likewise pivoted on two knife edges located on the upper flanges of the I-beams. This upstream frame is also fitted with sensitivity weights at its upper end, and is arranged to transmit the horizontal drag force as a vertical force acting on the scale pan of a Dayton balance. The four upper knife edges from which the two vertical frames are suspended are all in one plane. Similarly the two knife edges and cone pivot on which the subframe rests are all in another plane.

The horizontal spacing of these points of support is the same in both planes and the vertical spacing is the same at the upstream and downstream frames. By virtue of this the subframe remains horizontal as the balance swings, and the two vertical frames remain parallel as they swing out of the vertical. The balance includes a dash pot for damping oscillations.

The ratio of the moment arms is such that the balance indicates 1.83 times the drag force on the model.

The first test made with the subframe drag balance was to repeat the measurement of the resistance of the wooden model freely suspended with no ground effect included, the idea being to check the agreement between the subframe balance measurements and those made by observing swayback.

After correcting for wire drag, the resistance, R lb., of the freely suspended wooden model was found to be given by $\frac{R}{V^2} \times 100 = 0.1068$, compared with 0.1062, the value deduced from swayback measurements.

Use of a Dummy Ground

Fig. 1 shows the wooden model suspended from the subframe balance by four 16-gauge wires, and braced by two inclined wires of very small diameter. The dummy ground is shown in place; it was made to be over twice as wide as, and considerably longer than, the model, and was braced rigidly by wires. It was provided in side elevation with a rounded nose and a tapering tail, and was rectangular in plan form. This dummy ground was used throughout the remaining work.

The mean value over the speed range 0 to 130 ft. per sec. of the resistance R lb. of the wooden model with dummy ground present was found to be given by

$$\frac{R}{V^2} \times 100 = 0.1089,$$

where due correction has been made for the drag of the vertical suspension wires, but no allowance has been made for the drag of the inclined bracing wires.

The mean value of the resistance of the model, with no ground present, over the same speed range and uncorrected for the inclined wire drag was found to be

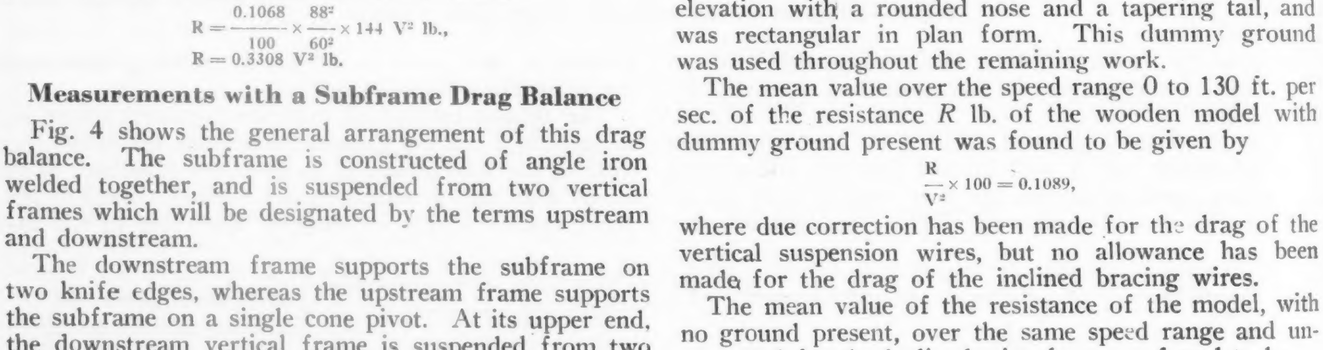
$$\frac{R}{V^2} \times 100 = 0.1149.$$

The mean value of the ground effect over the same speed range, obtained by averaging the differences between the two sets of readings whose mean values are given above, was found to be

$$\frac{d}{V^2} \times 100 = 0.0066,$$

which agrees very closely with the value of 0.0067 found by the previous method for determining ground effect, in which a mirror image of the model was used.

(*To be concluded*)



Air flow at 45 m. p. h. over modified model as indicated by silk threads

All-Welded Hopper Has Cast-Steel Underframes

Seventy-ton car with one-piece cast-steel underframe weighs 48,600 lb. The bed frame weighs 13,000 lb. The body design is especially adapted to fabrication by welding

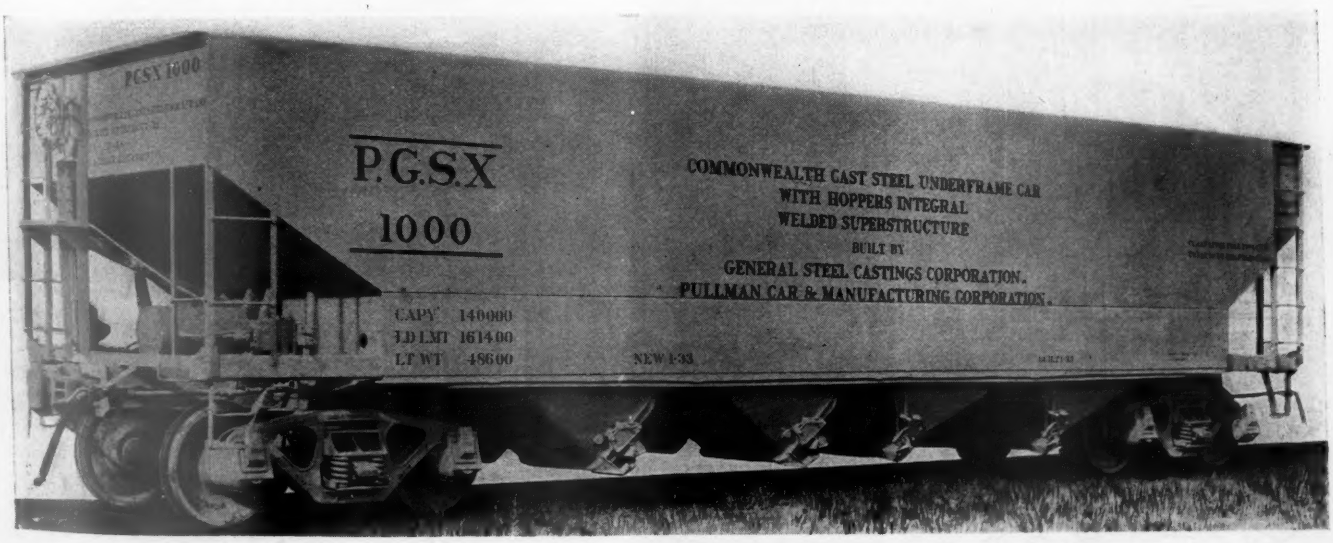
A 70-TON, all-welded hopper car with a Commonwealth cast-steel underframe has recently been built by the Pullman Car & Manufacturing Corporation in conjunction with the General Steel Castings Corporation. The car is designed to meet the requirements as regards general dimensions, capacity and hopper arrangement recommended by the Car Construction Committee of the A.R.A. Mechanical Division; to provide a car of high capacity per unit weight bv combining welded construction with a cast-steel underframe of special light-weight design; also, to assure a high degree of corrosion resistance, long life and freedom from maintenance expense by building an all-welded copper-bearing steel superstructure on an underframe of cast steel.

End view showing the new Type-AB brake equipment and other specialties

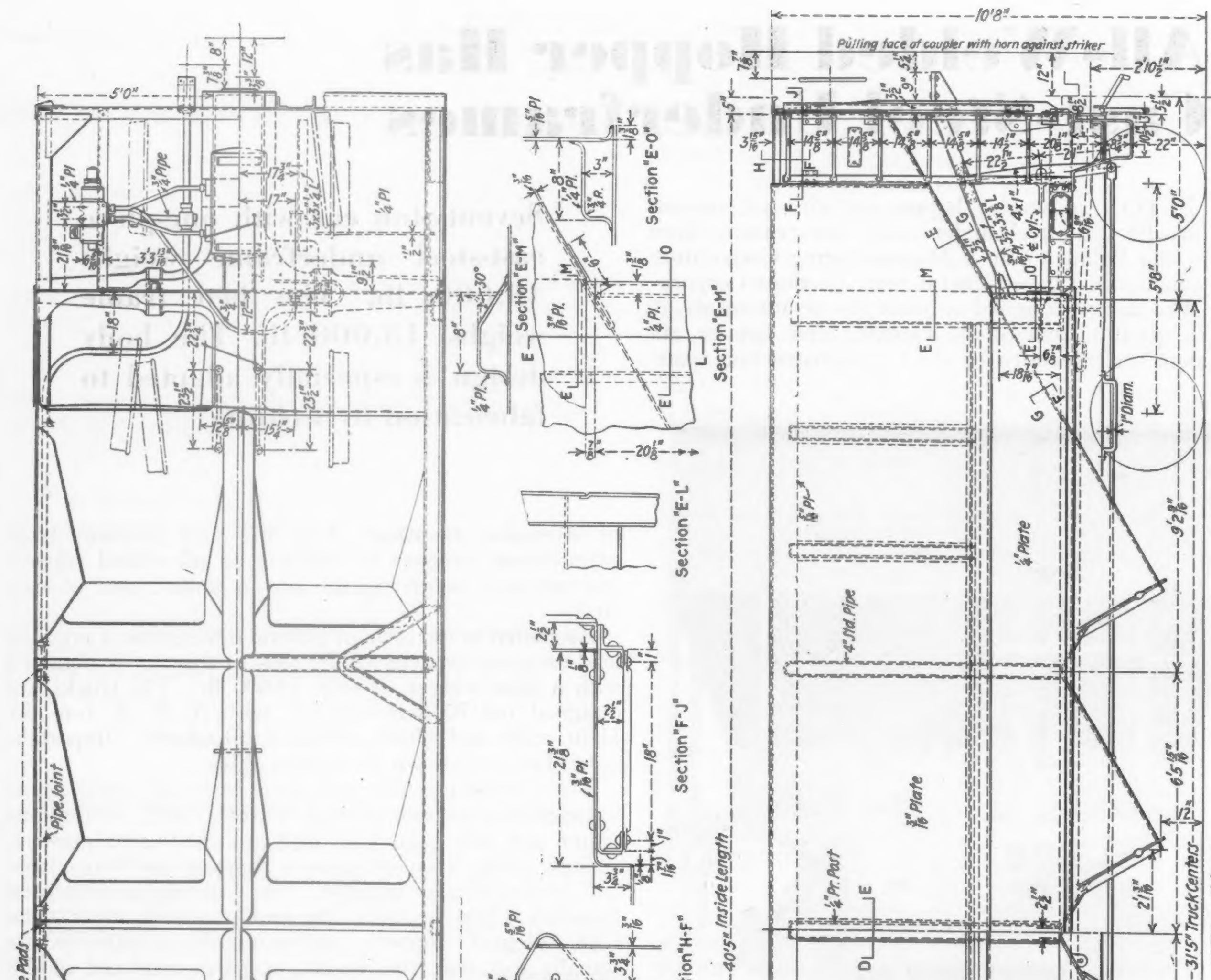
As shown in the table of general dimensions, a nominal load-carrying capacity of 70 tons in this car is obtained with a light weight of only 48,600 lb. The trucks are designed for 70 tons capacity, with A. R. A. 6-in. by 11-in. axles and 850-lb. chilled tread wheels. Important specialties are shown in another table.

The Commonwealth one-piece cast-steel underframe incorporates in one strong, durable unit, continuous center and side sills, body bolsters, draft-gear pockets, striking plates, coupler supports, hopper-door hinge lugs, and brake-cylinder supports, thus forming a substantial foundation for the car. The weight of this underframe with integral hoppers, approximately 13,000 lb., is actually less than the weight of parts displaced in the fabricated underframe designed for the standard A.R.A. 70-ton hopper car, and, in addition, the cast-steel underframe replaces 173 parts and about 2,000 rivets.

It is expected that the use of this type of underframe will effect a substantial reduction in maintenance charges over that required in the case of fabricated hopper-car underframes. In many cases, the replacement of rivets in fabricated underframes, which have been loosened in service, is only a small part of the necessary work, since much additional labor is involved in removing other parts



All-welded hopper car with cast-steel underframe

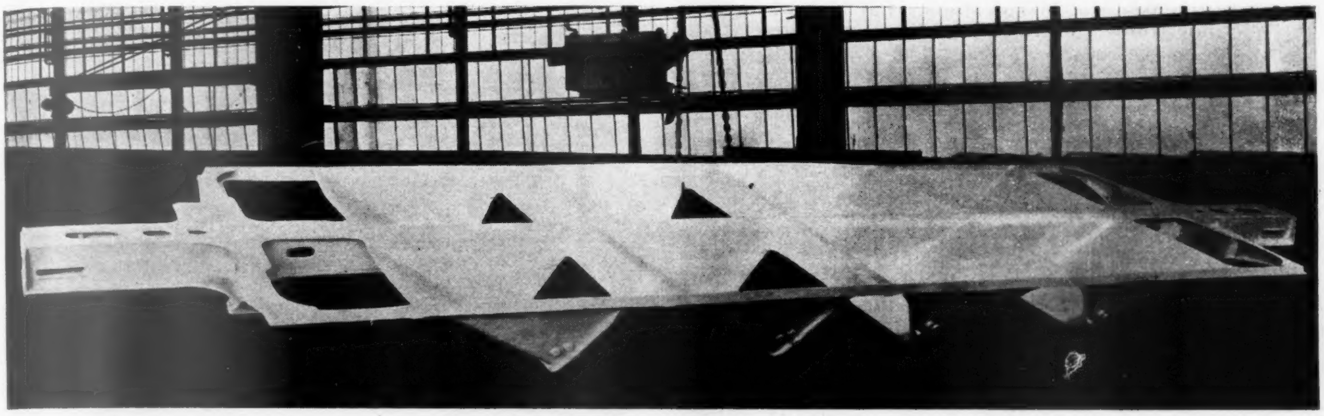


Plan, elevation and detail sections of the car

of the car to gain access to the portions actually requiring repairs. The advantages anticipated with the cast-steel underframe, therefore, include a reduction of actual repair operations and a substantially longer period between repairs, the car consequently being available for revenue service a larger proportion of the time.

The inherent characteristics of cast steel in offering high resistance to corrosion provides an additional important advantage in this underframe, which is expected to add greatly to the durability and life of the car. The employment of cast-steel underframe construction also permits rounding all the inside corners to assure complete clearing of the hoppers, which are of unusual width and capacity, thus facilitating the use of larger door openings and reducing the time required for the discharge of loads. The unusually large hoppers and door openings are made possible, of course, by the fact that the cast-steel construction permits a simpler center-sill design with a better distribution of metal. The use of large-capacity hoppers also lowers the center of gravity of the car.

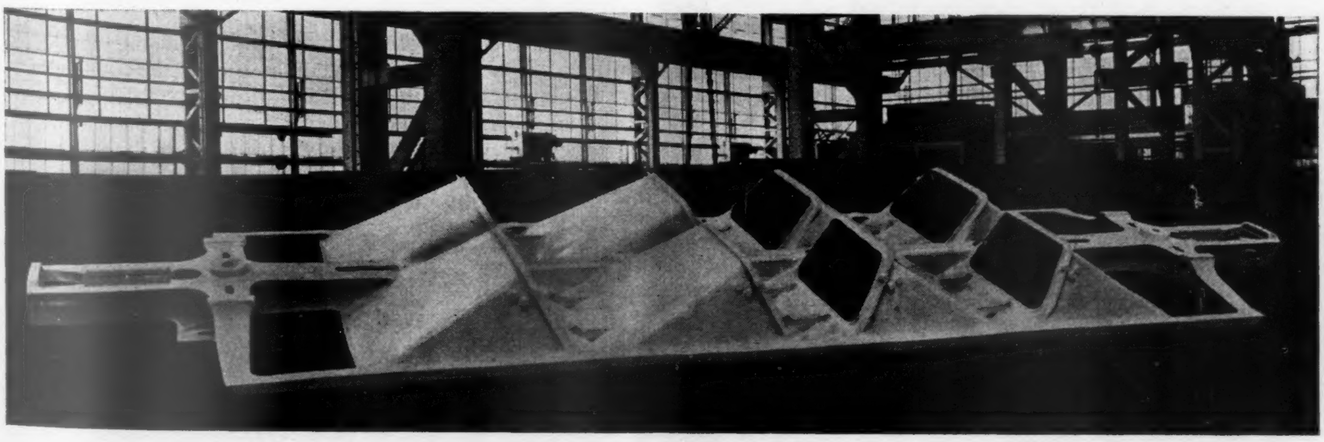
As designed by the Pullman Car & Manufacturing Corporation, the superstructure of the car is built up almost entirely of structural shapes and pressed plates, arranged so as to facilitate welding, which, in this case, was practically all done by the electric process, using coated welding rods and the latest improved welding practices. The entire technique of welding used in the construction of this car is the result of several years' exhaustive research and experiment by the car builder with various types of welding materials and methods in an effort to produce the particular characteristics required in welds at the various points of the car structure.



The cast-steel underframe

Several patented features are included in the construction of the car, aside from the underframe details. Among the most important of these are the side girder construction, the tubular lateral bracing provided to stiffen the car sides and a number of details of the end construction. In order to conform with the I.C.C. requirements, all safety appliances are riveted on. The door hinges, door spreaders, draft-gear carriers and miscellaneous brake parts are applied with rivets, as riveting is considered more desirable at these points than welding.

To make the car self-clearing, the main floor is sloped at 30 deg., and the lower side of the side top chord at 40 deg. Each side consists of two sheets, the top and bottom sheets being lap-welded at the horizontal seam. The horizontal side girth, pressed integral with the bottom side sheet, extends from bolster post to bolster post. The upper edge of the side is reinforced with a top chord pressed from a $\frac{5}{16}$-in. plate extending continuously from end to end inside the car. Fourteen side posts per car, pressed from $\frac{1}{4}$-in. plate, are applied on the inside of the car. The bolster posts are continuous from side top chord to the top of the underframe, being notched at the floor line to form a solid interlocking joint. At the ladder corners of the car, the side sheets are pocketed enough to keep the side ladders inside the clearance limits. The bottom side sheet laps the cast-steel side sill $1\frac{1}{2}$ in.



The underside of the steel underframe casting

The end sheet and the end floor plate are pressed integral from one $\frac{1}{4}$-in. plate extending from side to side of the car. The end top chord is a 5-in. by $3\frac{1}{2}$-in.

by ⅜-in. bulb angle applied directly to the top edge of the end sheet to form a butt joint. The floor sheet at the bottom edge laps the underframe 1 in. End sills are 3½-in. by 3½-in. by ⁵⁄₁₆-in. rolled angles applied with the horizontal leg upward, the edge of the vertical leg resting directly on top of the cast-steel center sill.

The bottom part of the bolster is cast as part of the underframe, the upper part being formed from a ⁵⁄₁₆-in. plate, flanged 6 in. along the top edge for supporting

General Dimensions of 70-Ton Hopper Car with Cast-Steel Underframe and All-Welded Superstructure

Length over striking castings	41 ft. 5 in.
Length inside	40 ft. 5 in.
Width inside	10 ft. 0 in.
Width overall	10 ft. 2¼ in.
Height from rail to top of car	10 ft. 8 in.
Centerplate height	2 ft. 2¾ in.
Truck centers	31 ft. 5 in.
Truck wheel base	5 ft. 8 in.
Side bearing centers	4 ft. 2 in.
Cubic capacity, level full	2,784 cu. ft.
Cubic capacity with 10-in. average heap	3,120 cu. ft.
Light weight of car	48,600 lb.

the floor. Side-bearing wear plates of 4-in. by 3-in. spring steel are applied, the side bearings being shimmed to produce a total side motion of ½ in. to ¾ in.

The inside bracing is built up of standard-weight wrought-iron tubing. The main braces extend from the side top chord at the side to the top of the center sill at the center. Each main brace, of 4-in. tubing, is stiffened by short struts extending down to the longitudinal side girth, the struts, made of 3½-in. tubes,

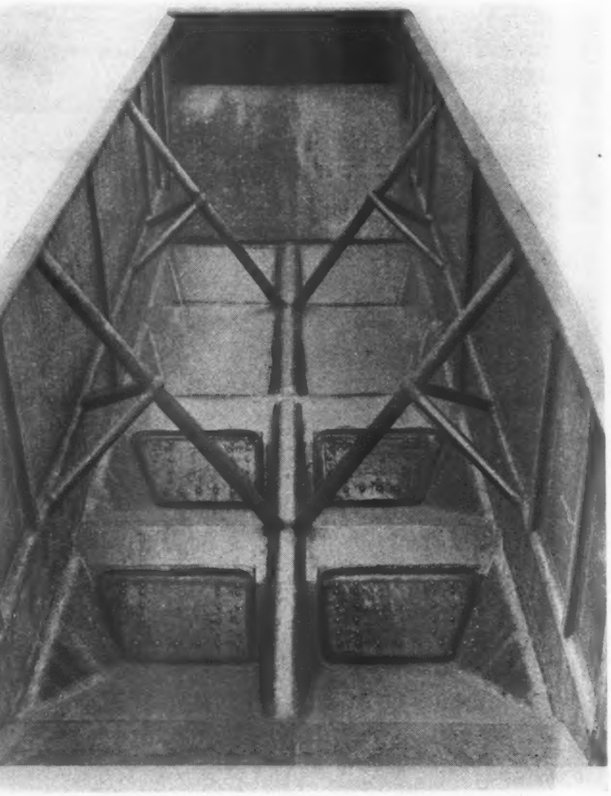
Specialties Used in Pullman General Steel 70-Ton Hopper Car

Underframe	Cast steel—General Steel Castings Corporation
Air brakes	1012 Type-AB—Westinghouse Air Brake Company
Draft gear	Type-NY-11-E—Cardwell-Westinghouse Company
Couplers	A.R.A. Type-E 6¼-in. by 8-in. shank, rotary bottom operating—American Steel Foundries
Coupler yokes	A.R.A. cast-steel vertical type, 24⅝-in. pocket—American Steel Foundries
Hand brakes	Ajax vertical wheel tyne—Ajax Hand Brake Company
Truck side frames	Cast-steel integral-box, double-truss type, arranged for coil elliptic springs—American Steel Foundries
Truck bolsters	Cast steel, integral centerplates, integral side bearings friction type—American Steel Foundr.es
Truck springs	Coil-elliptic spring arrangement, each group consisting of four A.R.A. double coil springs and one elliptic spring—American Steel Foundries
Journal-box lids	6-in. by 11-in. E-Z-On pressed steel—Railway Steel Spring Company
Brake shoes	Steel back—American Brake Shoe & Foundry Co.
Wheels	850-lb. chilled tread

spreading 60 deg. at the main tube. Two sets of bracing are required per car side, being applied at the cross-bearers.

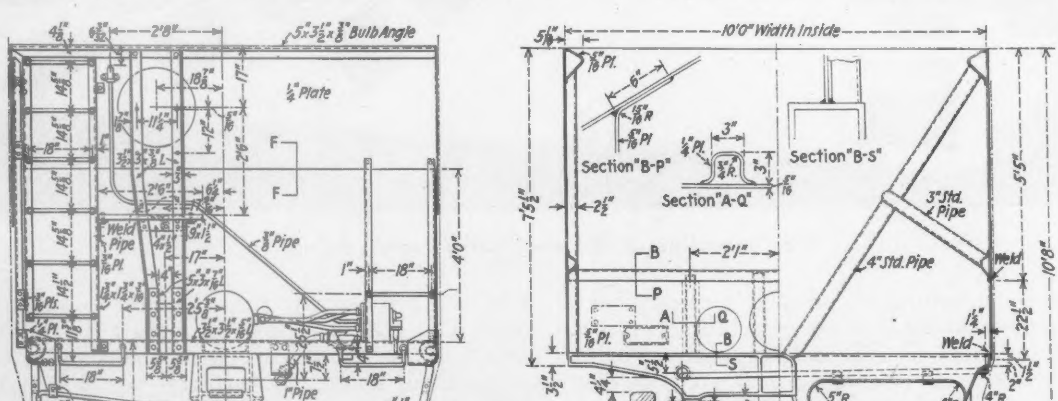
Eight drop doors per car, swinging transversely in pairs, are held in closed position with hooks. The doors are pressed from ¼-in. plate having a short outward flange and being pressed inward to follow the contour of the mouth of the door opening. Four door hinges, 2½ in. by ⅜ in., per door are riveted directly to the door plate. The spreader member tying the doors together is a 5-in. by 3¼-in. by ⁵⁄₁₆-in. Z-bar riveted directly to the door plate.

The brake levers are drilled to produce a braking power equivalent to 60 per cent of the light weight of the car with 50-lb. air pressure. The air-brake piping is



Interior of the car, showing the hoppers in the cast-steel underframe, the side bracing and other details

welded in place on the car instead of using the conventional U-bolt clamp, except at the angle cock where the U-clamp is maintained to allow easy replacement of the angle cock, if necessary. Similarly, the joints of the pipes are welded, the only fittings used being at the joints where they are needed to permit easy removal of the air-brake equipment for periodical cleaning.



End elevations and cross sections

Freight Traffic Officer Makes Some Suggestions*

How mechanical department can help build up freight traffic and protect the interests of the railways

THE Railroad Traffic Officer leaned back in his chair with a broad grin on his face. "I don't quite get you!" he said. "Are you spoofing me?"

"No," I said. "I am asking you a simple, straightforward question. What can the mechanical department do to assist in building up freight traffic?"

"But why ask me, of all people, to criticise the mechanical department? Don't you know that the traffic department is being pounded right and left these days because of lack of initiative and for failing 'to bring home the bacon'?"

"Nobody wants you to criticise the mechanical department," I said. "We are looking for constructive suggestions which will stimulate the mechanical department officers and employees intelligently to co-operate with the other departments in helping the railroads to build up their freight traffic."

R. T. O. paused for a moment, gazing out of the window into the distance. Then, "If you really want me to do so, I shall try to offer some suggestions, but for heaven's sake, don't use my name. I have enough trouble now, without inviting more brickbats—and I surely don't want to throw any at my associates."

Designing Locomotives for Traffic

"Traffic conditions," he said, "have changed greatly in recent years. Unfortunately, the mechanical department, under the spur of the operating department, is intent on building bigger and bigger locomotives. In doing this, however, it seems to pay little, if any, attention to the shippers' needs.

"It seems to me," continued R. T. O., "that the first thing the mechanical department should do, before designing a new locomotive, would be to call upon the traffic department for suggestions. Instead of that, the mechanical department entirely overlooks traffic considerations and goes merrily on designing larger and more powerful locomotives. Then, when they are delivered, it says in effect to the traffic department, 'Here they are; now go out and get the business for them'. Is it not quite possible that with the radical changes in modern distribution and merchandising methods, what may be really needed in most cases is not larger and more powerful locomotives, but lighter ones operating at higher speeds?"

"Wait a minute! Wait a minute!" I said. "You are going a bit too fast. You are indeed flattering the mechanical department by suggesting that it assumes an autocratic position in designing the power. As a matter of fact, it takes its orders from above and the executive and operating department officers must bear the full responsibility, since they specify the requirements which must be fulfilled by the new locomotives."

"That may well be," said R. T. O. "And yet, ought not the mechanical department officers to check up these specifications and do their full share in seeing that the railroad is placed in the best position to meet and overcome competition on the part of other types of transportation? Surely the mechanical officers confer with the operating and executive officers when the new designs are talked about—and surely they must also understand that today the prime requisite is to get the business back on the rails, rather than to further intensify the mass production methods of handling it. It looks very much as if we had already gone too far in the latter respect."

"You spoke a moment ago about radical changes in traffic conditions," I said. "Just what do you mean by that?"

Changes in Freight Car Design

"The railroads with the remarkable improvements in service inaugurated a decade ago, really started the hand-to-mouth buying movement," said R. T. O. "And yet, railroad equipment and operating methods are still based on the sales and distribution methods which existed prior to 1914. Do you realize, for instance, that in 1931 twenty-six per cent of all freight cars were used for handling l.c.l. freight, with an average load of about 4,700 lb.; and yet, this 26 per cent of the cars handled only about 2.5 per cent of all of the freight carried? Would it not be more reasonable frankly to face these conditions and design a certain percentage of the box cars specially for handling this class of traffic?"

"Just what would you recommend in the way of a special box car for this service?"

"My idea," said R. T. O., "is to design a four-wheel car, similar to the refrigerator car recently built by the North American Car Corporation. While it meets fully the strength requirements of the American Railway Association, it follows the European practice from the standpoint of capacity and wheel arrangement. This car has a capacity of 10 tons, measures 22 ft. 1 in. over the striking castings, and weighs 27,000 lb., although it is confidently expected that this weight can be considerably reduced when more cars are built. An ordinary box car of similar capacity and dimensions could, of course, be made still lighter."

"Just how would you operate these cars?" I asked.

"That, of course, would depend upon the traffic requirements," said R. T. O. "In my opinion, however, where there is a sufficient density of traffic, these cars can be operated in separate trains at passenger train speeds, thus guaranteeing faster service. There would also, of course, be no objection to using them in regular freight trains, since they meet all the requirements of the standard box car for strength. The problem of operating them would not be a difficult one and considerable savings would also be made in the reduction of the ratio of the dead weight carried. Undoubtedly, also, with the

(Concluded on page 164)

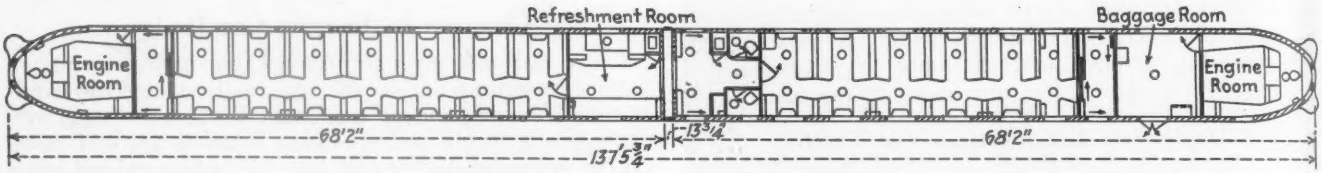
*The first of a series of interviews with officers of other departments, commenting in a constructive way upon the possibilities of the mechanical department.

Articulated Motor Coach On German State Railways*

The "Flying Hamburger" seats 100 passengers and has a regular operating speed of over 90 m. p. h. The structure is of light-weight steel, streamlined, and propelled by two 405-hp. oil-electric motors

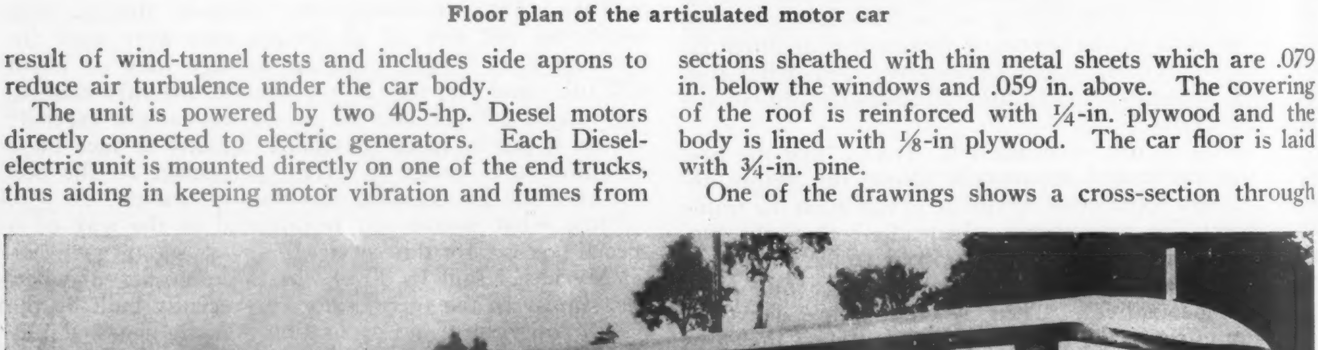
THE latest step in the development of reduced weight, high-speed passenger equipment on the German State Railways is a double, articulated unit, known as the "Flying Hamburger" from the fact that it has been placed in operation between Hamburg and Berlin. This unit provides seats for 100 passengers and is designed for a maximum speed of 99.3 m. p. h., a regular operating speed of 93.2 m. p. h., and an average speed of between 75 and 78 m. p. h. on the 179.2-mile run.

The equipment of the train consists of an articulated unit of two coach bodies carried on three four-wheel trucks. Much of the credit for the high speed which it has been possible to obtain with this vehicle is the result of the careful attention which was paid to streamlining in the construction of the body. The vehicle is too long to turn, and departure from the ideal streamlined form was necessary to provide equal resistance in both directions of motion. The form selected was the result of wind-tunnel tests and includes side aprons to reduce air turbulence under the car body.



Floor plan of the articulated motor car

The unit is powered by two 405-hp. Diesel motors directly connected to electric generators. Each Diesel-electric unit is mounted directly on one of the end trucks, thus aiding in keeping motor vibration and fumes from the car body. The center truck is equipped with two driving motors, one gear-connected to each axle.


The "Flying Hamburger"

Courtesy of the German Tourist Information Office, New York

The car body is 137 ft. 5¾ in. long overall, 9 ft. 3⁷⁄₁₆ in. wide outside and 8 ft. 10¹⁵⁄₁₆ in. wide inside. The maximum height over the rail is 12 ft. 2¹⁄₁₆ in. All three trucks have a uniform wheel base of 11 ft. 5¹³⁄₁₆ in. The weight in working order, including about 6,600 lb. of fuel but without passengers, is 170,576 lb., of which 54,824 lb. is carried on each of the two end trucks and 60,928 lb. on the center truck.

The framework of the body is a rigid welded structure of light weight which is built up of standard rolled sections sheathed with thin metal sheets which are .079 in. below the windows and .059 in. above. The covering of the roof is reinforced with ¼-in. plywood and the body is lined with ⅛-in plywood. The car floor is laid with ¾-in. pine.

One of the drawings shows a cross-section through the side wall and indicates the essential details of the body construction. The longitudinal members of the underframe are Z-bar side sills which follow the streamlined curves at the outer ends, thus forming a continuous enclosure into which the buffer is built. The transverse members are 5½-in. channels which are supported on top of the side sills. The vertical members of the body frame are secured directly to the sides of the side sills and are tied together longitudinally by a belt rail below the windows and a plate at the break of the roof. The cross-section indicates a liberal use of wood furring strips and window casings.

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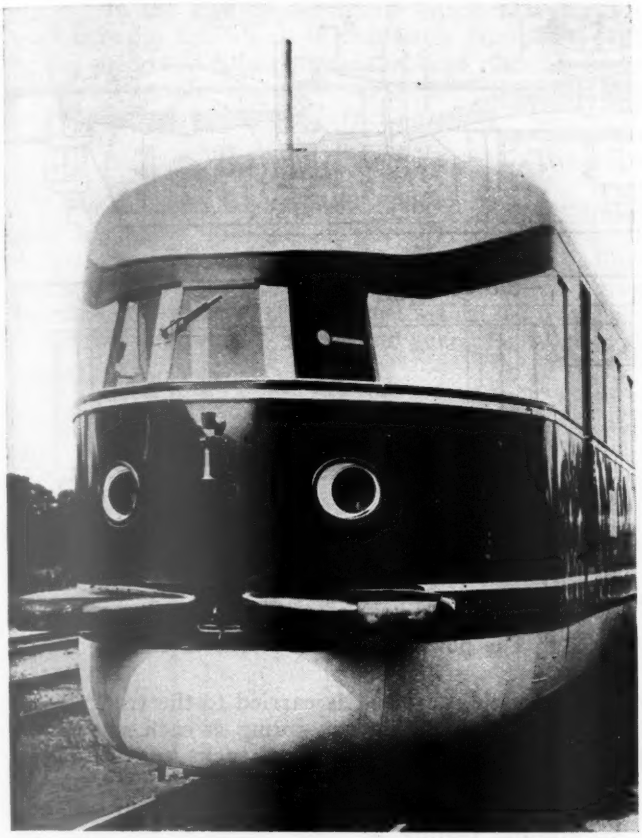
* The facts concerning the dimensions, weight and details of construction of the German high-speed motor coach contained in this article are taken from a paper entitled "Der Schnelltriebwagen der Deutschen Reichsbahn-Gesellschaft," by Reichsbahndirektor Dr. Ing. E.h. Friedrich Fuchs and Reichsbahnoberrat Max Breuer, Berlin, which appeared in the January 21, 1933, issue of Zeitschrift des Vereines Deutscher Ingenieure.

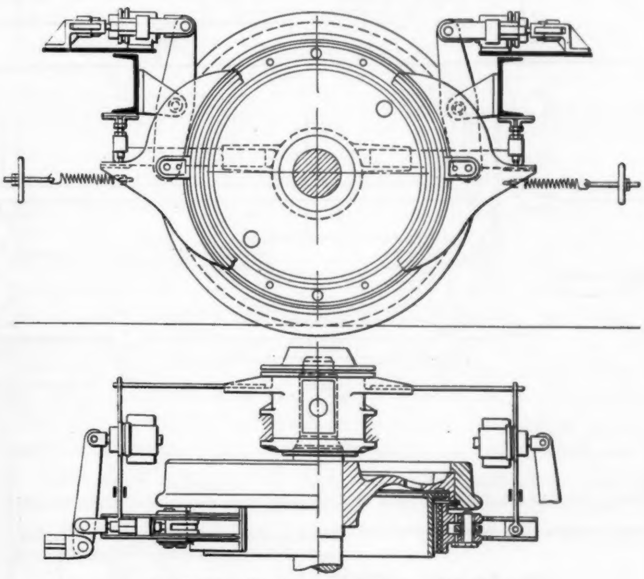
The adjoining ends of the two halves of the coach body are carried by a double spherical support which is seated on the center plate of the center truck. No other buffer or coupling device is provided between the two bodies, but provision is made for hauling the cars by means of an eye-ring at each end to which a coupling carried inside the coach may be attached when necessary. Streamlined buffers at each end of the body underframe are cushioned with semi-cylindrical rubber springs to protect the light coach from damage from accidental contact with other cars.



Courtesy of the German Tourist Information Office, New York

The streamlined end of the "Flying Hamburger"

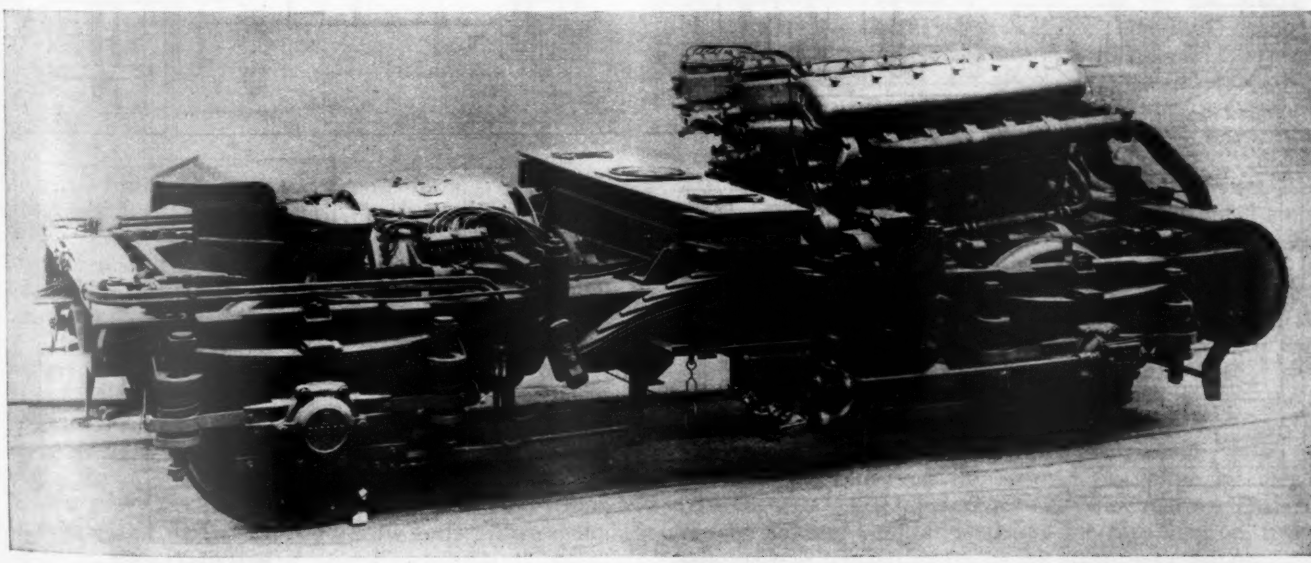
Passengers are carried in two compartments, one in each half of the body. The seats are of the Pullman-section type and are arranged for three persons on one side of the car and one on the other. In addition to the passenger compartment, a small baggage room behind the engine room and two lavatories are provided on one half of the unit, and a buffet which serves both hot and cold drinks and sandwiches is located in the other half of the unit, at the center. These refreshments are served in the sections. The heat for boiling water is obtained by utilizing the electric current flowing through the generator field regulating resistance. In order to make the heating of the cars independent of the rate at which the power plants are working, a special independent heating boiler is installed in each half of the vehicle.



Detail of the drum-type brake

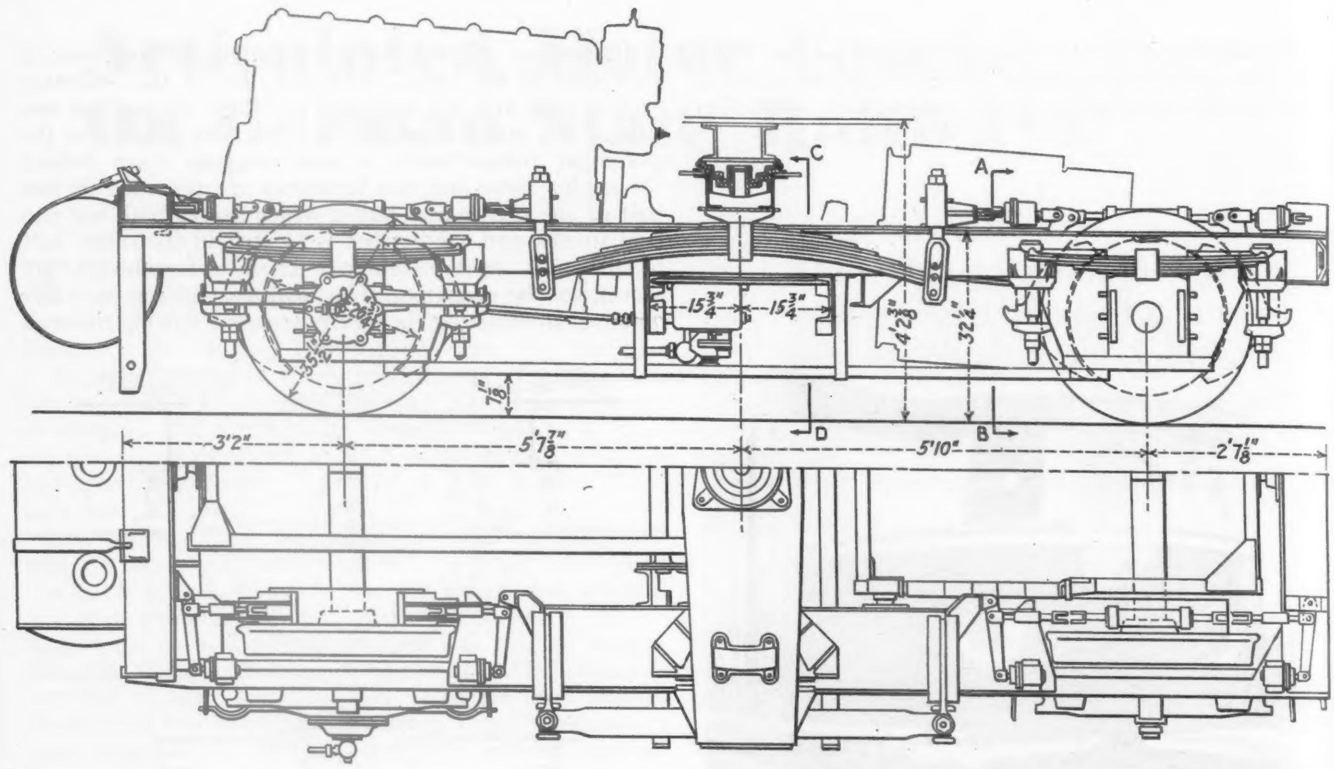
The Trucks

The truck frames are built up from rolled sections and plates by welding, with riveted or bolted connections for detachable parts. The truck frames are supported at each journal box by a flat plate spring and two helical springs of square-section steel, one in each plate-spring

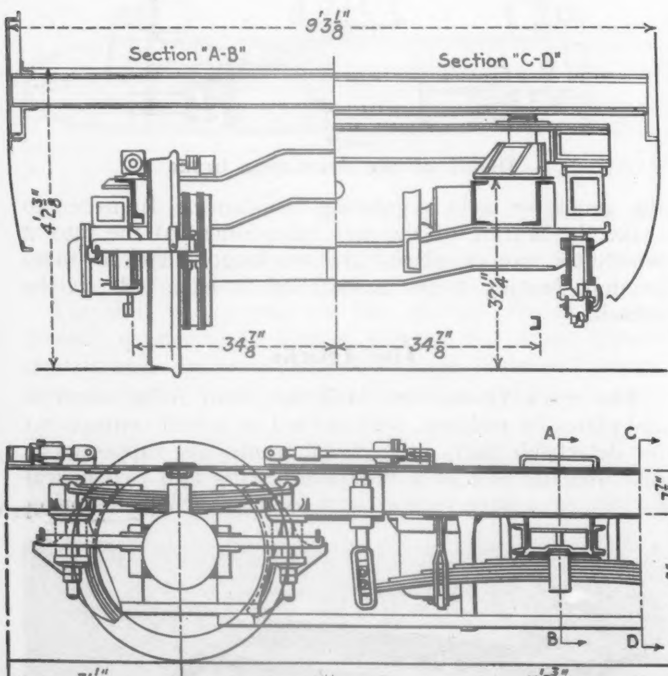


Courtesy of the German Tourist Information Office, New York

One of the power-plant trucks

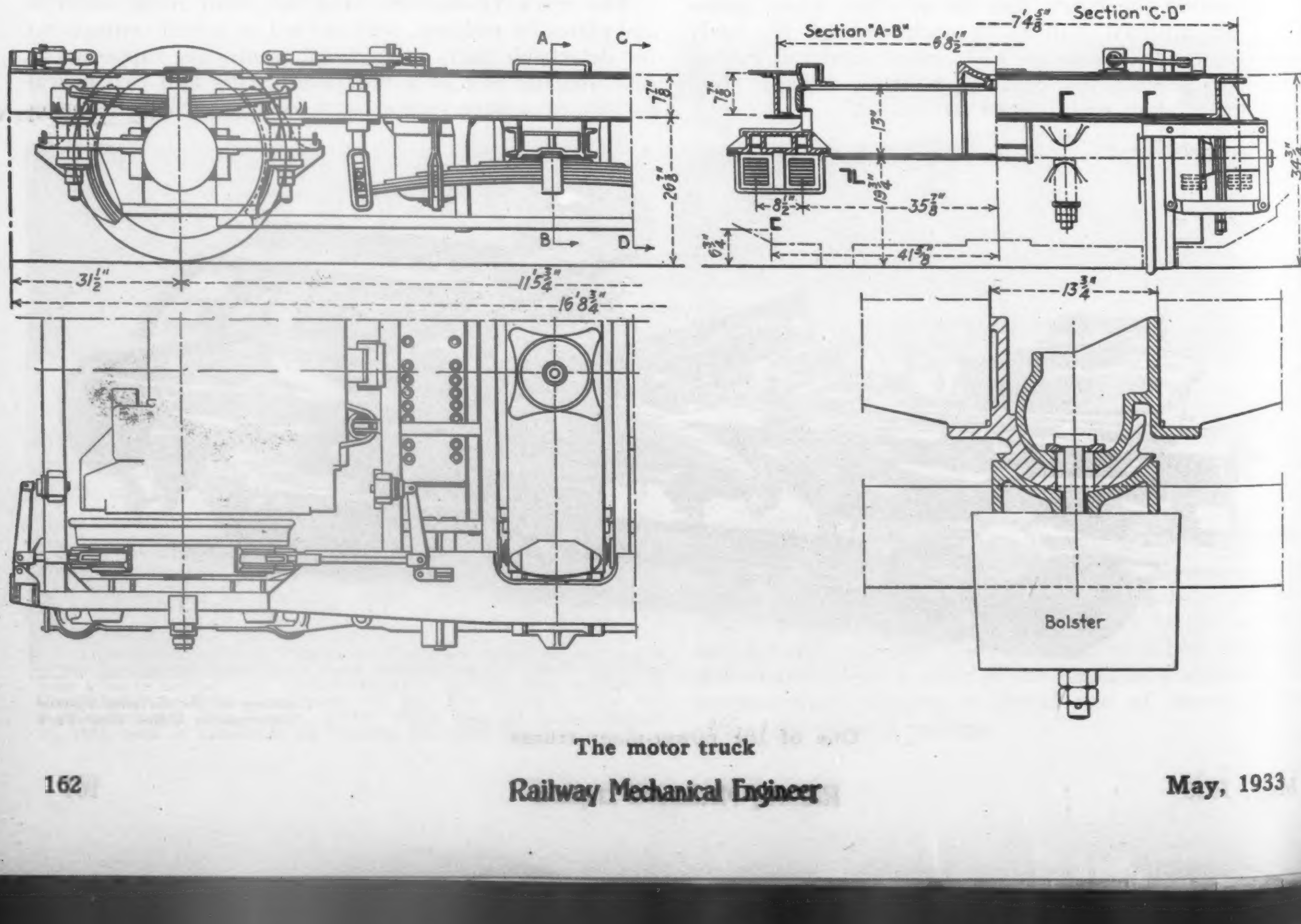


The power-plant truck construction



hanger. The bolster load is carried to the truck frame by a single longitudinal plate spring at each side of the truck in the case of the two end trucks and by double plate springs at each side of the center truck owing to its greater load.

An unusual feature of these trucks is the provision of a cast-steel brake drum at each wheel. These drums are 26¾ in. in diameter on the end trucks and 30¾ in. in diameter on the center truck. The two large clasp brake shoes which operate on these drums have friction linings, each brake shoe being provided with its own

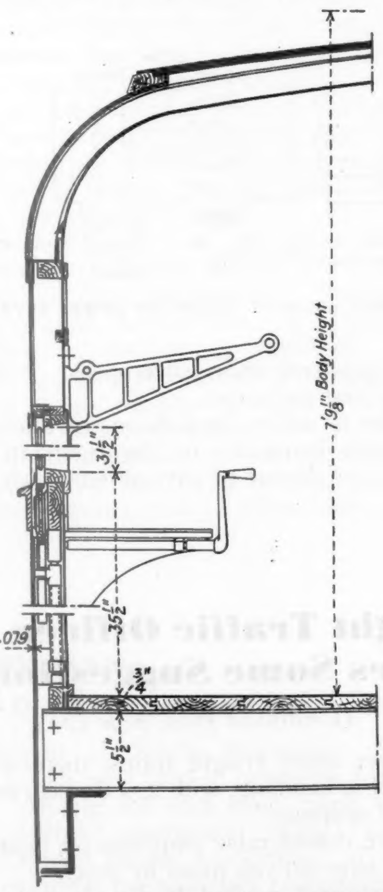


The motor truck

small operating cylinder. The eight brake cylinders on each truck are supplied from a common auxiliary reservoir and Knorr quick-acting valve. The brake drums are attached to the inside of the wheels on the two end trucks. In the case of the center truck, however, the space between the wheels is completely occupied by the driving motors and the drums have been placed between the wheels and the journal boxes on the outside. Roller bearings are provided on all truck journals.

The Power Plant

Power is provided by two Maybach Diesel engines, each developing 405 hp. and directly connected to an electric generator through a flexible coupling. Each engine-generator set is mounted in one of the end trucks. To relieve these power units of stresses caused by torsion in the truck frame, each engine and generator is mounted



Cross-section through the side of the car

in a sub-frame which has a three-point suspension within the truck frame.

The car is driven by two nose suspended electric motors, one driving each axle. Current from each generator is led directly to the corresponding electric motor on the center truck.

The Maybach engines are 12-cylinder, V-type and operate on solid fuel injection. They deliver their continuous output of 405 hp. at 1,400 r.p.m. and have a one-hour rating of 424 hp. The cylinders are 5⅞ in. in diameter by 7⅞ in. stroke. Each motor weighs 4,476 lb. The fuel consumption at the most economical load is .401 lb. per hp.hr. Roller bearings are provided for the crank shafts and connecting rods. Two cylinders drive on each crank pin.

The power is controlled by the regulation of engine speed. The controller handle operates to regulate the governor spring, the power delivered to the motors thus being controlled simply by raising or lowering the speed of the Diesel engines. A reversing switch is the only control required between each generator and its motor.

A 96-volt storage battery is used in order that the starting current and the cross-section of the starting winding may be kept within reasonable limits. Half of the battery is used for the lighting of each half of the coach, but the other auxiliary circuits operate at the full voltage of the battery. A lighting generator is driven from each Diesel set. This charges half of the battery and provides normally for the lighting circuit. These generators develop their full voltage at 750 r.p.m., the light-load speed of the Diesel engines.

On the Berlin-Hamburg line the distance signals are 3,936 ft. in advance of the home signals. It is possible to bring the high-speed motor coach to a standstill from its maximum speed within this distance with the improved braking equipment. The car is also equipped with supplementary electro magnetic track brakes which are used only in case of emergency. The retarding effect of these brakes is independent of the adhesive weight of the car. In each of the two Diesel trucks there are four braking magnets, 29½ in. long, and in the center truck are two magnets 39⅜ in. long. An oil-pressure hand brake acting on the power-brake drums is used in switching and when the vehicle is parked. The cars are provided with inductive train-control equipment. The unit may be operated from either end.

The development of the car has occupied slightly more than two years and it is said that in all stages of the test and trial runs the expectations of the designers have been fully realized.

The car was built by Waggon u. Maschinenbau A. G., Gorlitz. The electric transmission system was furnished by the Siemens Schuckertwerke.

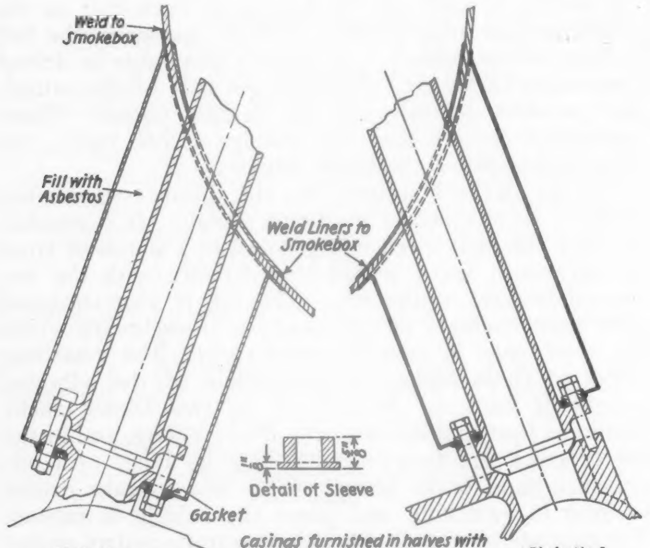
Locomotive Steam Pipe Casing

An improved locomotive steam pipe casing, invented by H. E. Riccius, master mechanic of the Chicago, Milwaukee, St. Paul & Pacific at Miles City, Mont., has been perfected and placed on the market recently by the Wilson Engineering Corporation, Chicago, following a series of extensive service tests on two western carriers which have adopted it as standard practice. The principal object of the new casing is to provide a relatively inexpensive and effective means of insulating outside steam pipes and, at the same time, prevent air leaks into the locomotive front end, due to expansion, contraction or vibration of the steam pipes.

The casing, as shown in the illustration, is furnished in two halves for ease of application, being welded along front and back longitudinal seams. The casing is applied in two different ways, dependent upon the type of cylinder steam pipe connection; whether it has an extended flange and bolted connection, as in style No. 1; or a flush joint with holding studs threaded directly into the cylinder casing, as in style No. 2. With either design, the casing is flanged and welded to the smoke box at the upper end, as illustrated, also being provided with a square flange at the lower end, which makes an air-tight joint against the steam-pipe flange by means of a special gasket. Bolt sleeves which are a close fit on the holding bolts or studs, as the case may be, transmit the bolt tension direct to the steam-pipe flange.

The purpose of the bolt sleeves is to permit drawing up the ground ball joint of the main steam-pipe connec-

tion, at the same time compressing the gasket which is independent of this main joint, and thus prevent air leaks. Variations caused by expansion and contraction of the steam pipes are provided for by the extended lower flange of the casing. The casings may be filled with asbestos. Liners are fitted to the steam pipes inside the smoke box and welded in place. Dimensions necessary in ordering the casing are shown by letter in the drawing. Unless the hole spacing and size are specified, the flanges are furnished blank and undrilled.



Two types of the Wilson locomotive steam pipe casing

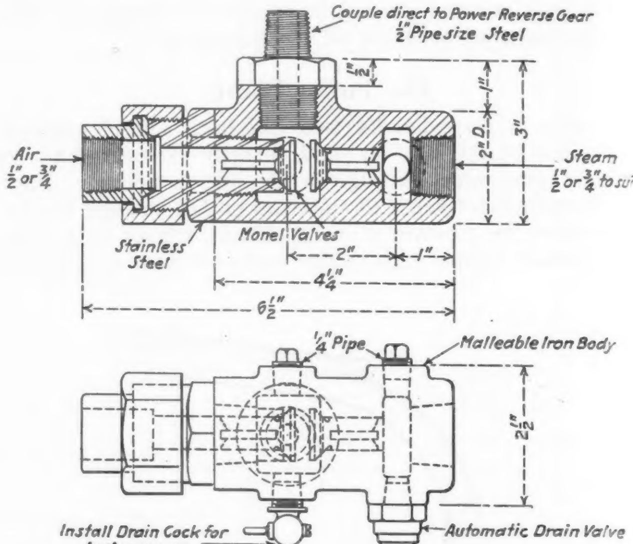
While this design of locomotive steam-pipe casing, particularly style No. 2, does not permit the ready removal of steam pipes without cutting away the casing, in locomotives of modern design it is seldom necessary to remove the steam pipes except occasionally for a leaky joint, cracked header or other emergency repairs. In that case, the difficulty of occasionally removing light casings, even if more or less permanently welded and bolted in place, is far more than offset by the many months of air-tight service which the casings have rendered.

Automatic Cut-Over Valve

THE new ruling of the Bureau of Locomotive Inspection, which forbids a common pipe, for steam and air, between the locomotive cab and the reverse gear, appears to affect many existing installations.

Separation of the steam and air leads means dispensing with a common three-way cut-over valve in the cab, and substituting two independent valves. There then remains the necessity for providing against the possibility of crossing steam over into the air system of the locomotive.

Such a provision is made in the device illustrated, which has recently been developed by the Wilson Engineering Corporation and patents applied for. This automatic cut-over valve for power reverse gears is designed to be simple and yet completely reliable. It has a malleable-iron body and Monel-metal valves, one of which is provided with a stainless-steel seat to resist corrosion. It will be observed that a number of check valves, pipe fittings, and threaded connections are made unnecessary by the use of this valve which automatically cuts out air when the steam is applied. When the steam is shut off and air is again applied the steam line is cut off and an automatic drain valve opens. A drain cock is installed for test purposes.



Automatic cut-over valve for power reverse gear

This device is said to have the approval of the Bureau of Locomotive Inspection of the Interstate Commerce Commission for the use of any carrier which may choose to adopt it.

Freight Traffic Officer Makes Some Suggestions

(*Continued from page 159*)

lighter, higher speed freight trains, there would be an improvement in handling, with less damage to the equipment and its contents."

"You place considerable emphasis on lighter cars," I said. "Just what do you mean by that?"

"In my opinion," replied R. T. O., "the mechanical department should take full advantage, particularly in a brand new class of cars of this sort, of the really wonderful improvements in materials and methods of fabrication which have been perfected in the last few years. These improvements are little less than marvelous. The railroads up to now have used them only to a limited extent in an experimental way. We must, however, reduce the dead weight of the equipment to a minimum if we are successfully to compete with other types of carriers.

"One other thing I should like to add," he said. "Incorporate in this new equipment every device that will insure smooth and easy riding and eliminate possibilities of rough handling. You have no idea what a black eye damage to shipments by rough handling has given the railroads. It must be eliminated. Starting from scratch with these new four-wheel freight cars, there is no reason, in my opinion, why full advantage should not be taken of all these things."

EDITORIALS

As Others See Us!

Beginning with this issue of the *Railway Mechanical Engineer* we plan to publish regularly a series of interviews with officers of other departments, commenting upon the possibilities of the mechanical department as they see it from the outside. The different departments of the railroads are not enclosed in air-tight compartments; they work in a common cause and the effectiveness of the railroad as a whole may be measured by the extent to which these departments wholeheartedly co-operate and feel that they are an integral part of one organization, with one common purpose.

How can the mechanical department co-operate with the other groups to the very best advantage? Surely it will prove helpful if constructive suggestions are received from those outside the mechanical department, and yet who are associated with it in a common cause. It was with this thought in mind that the *Railway Mechanical Engineer* planned a series of interviews with representatives of other departments. They are not intended to be critical, but rather to be helpful and constructive. Railway mechanical department representatives may not agree with some of the suggestions that will be made. If so, we hope that they will feel free to express themselves. Or possibly they can see ways in which some of the suggestions can be carried out and be made effective. We should like nothing better than to conduct a lively open forum on these interviews in our Reader's Page.

Locomotive Smoke Abatement

The Department of Smoke Regulation for Hudson county, N. J., has now been in operation for more than two years. Among the first steps taken was that of calling the railroad mechanical officers together and forming a Railroad Smoke Association. This organization meets monthly, the members exchanging ideas and experiences. Its efforts and those of the Department of Smoke Regulation are strikingly indicated in the results which have been obtained. The locomotive smoke density, as measured by the Riegelman chart, was reduced from an average of 16.03 in 1931, to 5.20 in 1932, or a reduction of 67 per cent. The figures are fairly comparable, since the observations were made uniformly over these years and on each road in the proportion to the locomotives operated within the county. The New York Central headed the list with the best record for 1932, the Central Railroad of New Jersey being a fairly close second. Seven other railroads operate in the county, some of them, however, trailing far behind the leaders in their locomotive smoke abatement records.

The roundhouses have been found among the worst offenders in the making of smoke, largely because of the building of new fires in the locomotives. The improvement in this respect for 1932, as compared to 1931, was almost as striking as that of the reduction in density of smoke from locomotives. Special efforts have recently been concentrated upon roundhouses, however, and substantial progress has been made in still further improving the record. The railroads can take real satisfaction in the results of their co-operation with the Department of Smoke Regulation. Undoubtedly, also, with the abatement of the smoke there has come a reduction in fuel consumption and more efficient operation.

The Father of the Steam Locomotive

We think of the motor car as a recent development, compared to the locomotive, and yet experimental steam road carriages antedated the first steam rail locomotive by many years. Nicholas Joseph Cugnot, a Frenchman, as early as 1769, built a steam-driven carriage to operate on ordinary roads. It carried four people and ran at a speed of three or four miles an hour, but only had sufficient boiler capacity to go for 12 or 15 minutes without stopping to get up steam. His second steam-driven carriage made several successful trips on the streets of Paris, but one day in turning a corner upset with a crash, and the authorities, believing it to be dangerous, put a stop to further experiments.

Watt's steam engine, perfected in 1776, was used largely for mining operations. It was a cumbersome device, since it operated at low pressures and depended on the vacuum produced by the condensation of the steam.

Richard Trevithick, born in 1771, and a much younger man than Watt, succeeded in 1800 in building a high-pressure (for those days), non-condensing steam engine, which almost immediately became a successful rival of Watt's engine. On Christmas Eve, 1801, Trevithick made the first trip with a common road vehicle driven by one of his engines. It carried a number of passengers over a difficult grade and a few months later Trevithick, with his cousin Andrew Vivian, applied for a patent for steam engines in propelling carriages. Two years later another steam-driven road carriage, made by Trevithick and Vivian, operated successfully over the streets of London. A year later, in February, 1804, Trevithick placed in operation on the Pen-y-darran tramway, in Wales a steam rail locomotive, which successfully hauled a load of 10 tons of iron and about 70 passengers a distance of nine and one-half miles. It was operated for a short time, but the track construction was not sufficiently strong for the weight of the locomotive and its use was discontinued. A similar locomotive was supplied to the Wylan Colliery at Newcastle in the following year. In 1808 Trevithick constructed a circular railway in London, on which passengers were carried by a steam locomotive, at the rate of 12 or 15 miles an hour.

Trevithick was clearly the first to construct and operate steam-driven rail locomotives. He was the first to realize that the friction of wheels on the rails was sufficient for the traction on ordinary grades. He used a bellows to furnish draft for the fire, but it is interesting to note that the steam was exhausted out of the stack; he did observe that this helped the draft, but con-

sidered it necessary to continue the use of the bellows on all his locomotives.

Unfortunately, while Trevithick was a most capable inventor and possessed great ability and ingenuity, he was lacking in perseverance, and it was left to George Stephenson to perfect the locomotive. As Samuel Smiles expressed it: "He struck out many inventions, and left them to take care of themselves." Trevithick, however, must be regarded as the father of the steam locomotive. Because of his contributions, not alone in road and rail transport, but to the application of his engines in pumping in mines, blowing furnaces, iron manufacture, dredging, propelling vessels and threshing corn, the British engineers in April of this year suitably recognized the centenary of his death, which occurred on April 22, 1833.

The versatility of the man may be recognized from the fact that he spent much time in the application of power to mining in Peru and Costa Rica. He was one of the first to recognize the importance of iron in the construction of large ships, and also did much to encourage the application of steam to agricultural processes. In a letter to the British Board of Agriculture in 1812, he indicated his belief that every part of agriculture might be performed by steam, and that such use of the steam engine would "double the population of the Kingdom and make our markets the cheapest in the world."

It is a far cry from the Trevithick locomotive of 1804 to the triple expansion, high pressure steam locomotive which has just been placed in service on the Delaware & Hudson, but to Trevithick must be given full credit for blazing the trail in the early days.

Car-Wheel Grinding

It is generally estimated that 15 to 20 per cent of all car-wheel removals are required on account of the development of slid-flat spots. According to the recommended practice of the A.R.A., Mechanical Division, many of these wheels, whether cast iron, cast steel or one-wear wrought steel, may be reclaimed by grinding the entire circumferences of the mounted wheels in a machine which finishes the treads concentric with the journals. While quite a number of roads are reclaiming car wheels more or less extensively by this method, and by long experience know exactly what technique to follow in getting the desired results, it may well be doubted if maximum economies are even yet being secured from car-wheel grinding.

One of the most interesting recent comments on the grinding of car wheels was made by F. G. Moody, master car builder of the Northern Pacific, in a paper before the March meeting of the Western Railway Club. He stated that the Northern Pacific follows the general practice of grinding all chilled-iron car wheels with flat spots less than 3 in. in length, providing the wheels are otherwise in good condition, new wheels being ground when not enough slid-flat wheels are available to keep the grinding machines busy. These new chilled-iron car wheels are ground in order to remove roughness, high and uneven spots and assure wheel treads concentric with the journals, the records indicating that about 1,000 pairs of new wheels are ground per year at a direct average labor cost of 30 cents a pair.

Since being installed in 1928 and 1929, the two 44-in., heavy-duty grinding machines on the Northern Pacific have been used (up to January 1, 1933) in the reclamation of 8,583 pairs of slid-flat wheels at a total cost of $1.30 a pair, including labor, material and general overhead expense, or a total of $11,158. The net saving on this number of reclaimed wheels is estimated to be approximately $100,000. Experience on the Northern Pacific indicates that this road gets about the same mileage from wheels reclaimed from grinding as from new wheels which are not ground.

Proper practices in the reclamation of car wheels by grinding, together with the economies to be expected and limitations observed, are set forth very concisely and clearly in the Wheel and Axle Manual, issued by the Mechanical Division. A review of the section of this book devoted to wheel grinding is well worth while for all car-department officers who are considering a more extensive use of this practice. The success of wheel grinding apparently depends very largelv on the selection of the proper wheels to be ground and a strict adherence to the authorized methods of grinding set forth in the manual.

An Important Void In Locomotive Operation

Among other charts of special interest in the article on modern locomotive ratios by A. I. Lipetz, published recently in the *Railway Mechanical Engineer,* it may be worth while to direct particular attention to the representative tractive-force-horsepower-speed curves, which appeared as Fig. 15 on page 121 of the April issue. The development of this chart of locomotive road test results, measured by a dynamometer car, presents valuable information, as it should, in view of the considerable expenditures of time and money required in securing the data. An easily filled void is evident, however, in the lack of information, indicating the cut-offs used by the locomotive while producing the tractive forces and horsepowers recorded for the various speeds.

Locomotive road tests answer many practical questions and yet, too often, these satisfactory answers are not translated into actual use. However easy it might be to include the information, performance charts do not usually show the cut-offs which did produce, and which will invariably reproduce, the maximum tractive forces and horsepowers exhibited, notwithstanding the fact that other cut-offs, either higher or lower, will not serve. Definite cut-offs are necessary to successful maximum operation; to the satisfactory handling of a desired tonnage over any controlling section of any run; to the maintenance of schedule; to an increase in tonnage or to the reduction of running time, or to both. It would appear at least questionable practice to give an engineman an expensive modern locomotive and then ask him to guess how long the reverse lever should remain "in the corner" at starting, estimate the proper time and amount to move the reverse lever, and then guess at every other reverse-lever and cut-off adjustment required at various speeds to produce maximum results.

The chart referred to shows a curve of maximum performance, traced through the highest points of actual and calculated values, reaching 3,200 hp. at 50 m.p.h. Evidently, these points were selected at random in a search over yards and yards of dynamometer record for unusually high tractive forces. A curve of mean or average performance is also traced, reaching a maximum of 3,000 hp. at the same speed, 50 m.p.h. and it would be possible to trace a third curve through the minimum points, indicating but 2,800 hp. developed at 50 m.p.h. Differences in cut-off produced the signifi-

cant differences shown in power development at 50 m.p.h. as they will at other speeds, and unquestionably, it is highly important to prevent this loss of 200 to 400 hp., or more of valuable power capacity, which may be just the differential needed to get a train over a grade, or make up time on a fast schedule.

Quoting the last report of the A.R.A. Mechanical Division, Committee on Locomotive Construction, "The problem of supplying a satisfactory guide for, or method of controlling cut-offs of locomotives, is one which has been given considerable study and investigation during the past few years—every worth-while effort which has been made toward the solution of this problem deserves thoughtful consideration." Back-pressure gages are being used on many locomotives to assist enginemen in maintaining the predetermined back pressure essential for the development of desired locomotive capacity. An automatic cut-off control device, also actuated by back-pressure, has been installed on 96 locomotives on 13 railroads with generally satisfactory results. A cut-off indicating device, based on locomotive speeds, has also been developed for the guidance of enginemen and applied to about 600 locomotives on 16 roads. This device provides continuous records of speeds and cut-offs used, being credited by the committee with "a substantial saving in fuel, as well as an increase in tonnage rating." It is perhaps only natural to wonder what condition has heretofore prevented the development of an automatic cut-off control device actuated directly by locomotive speeds, for each of which there is one and only one cut-off which will unfailingly produce the desired maximum results.

In the automotive field, the electric spark or timing adjustment for the gasoline engine has been removed entirely from the control of the driver and is regulated far more efficiently by automatic means. For how long will hit or miss methods of cut-off adjustment be permitted in locomotive operation and enginemen left more or less in the dark regarding the cut-offs which must be used to produce most efficient locomotive performance?

Equipment Weight And Safety

When the development of rail motor cars began to arouse a new interest in the question of passenger-car weights about a decade ago, many railroad officers regarded with apprehension the operation of the then light-weight motor cars and trailers on the same rails with the massive rolling stock built for steam trains. Obviously the use of rolling stock of the light design then employed in motor cars and their trailers, mixed in trains with the heavy steel cars, would have subjected the lighter and weaker structures to almost certain destruction in case of collision. The fear that the same result would follow in case of collision between trains of the light and the heavy rolling stock was less fully justified.

In considering the relation of weight to safety, it must be remembered that as weight is added to increase strength, the energy which the car structure must dissipate without destructive effect increases as a result of the added weight. To justify itself, weight added to a car structure for safety's sake must increase the strength of the structure to withstand collision shocks more in proportion than the increase in weight. For example, suppose passenger coaches operating in ten-car trains are increased in weight by 10 per cent, then in case of a collision shock it is probable that some car in the train will be required to absorb an added amount of energy equal to that stored in one additional car of the former light weight. Since part of the energy stored in each car is absorbed by its own structure and part by the draft gears, the cumulative effect on the car against which the collision force is applied is considerably less than the total energy stored in the train, while all of the additional energy resulting from an increase in weight will be transmitted. The increase in the severity of the shock will, therefore, be considerably more than 10 per cent.

On the other hand, if we were to consider a car designed for single-unit operation and assume that it be brought into collision with a heavy steam train, the destructive effect of the blow to which this car is subjected is determined primarily by the energy stored up in its own mass, not by the energy stored in the heavier train.

It may be seriously questioned if the weight of much of the present steel passenger equipment has not passed the point of diminishing returns with respect to safety and, if this be true, then the disadvantages of excessive weight make it an unjustified economic burden. One of these disadvantages of excess weight is the burdensome demand upon motive-power capacity. Another is increased maintenance cost. The third is increased difficulty of providing satisfactory cushioning of shocks between the cars of passenger trains. Since the energy of motion is proportional to weight, the energy which must be absorbed by whatever cushioning device is provided between the cars increases directly in proportion to the weight of the vehicles. It is evident that the energy which must be handled as the result of slack action in American passenger trains has long since exceeded the possibility of smooth cushioning action within the narrow limits of permissible movement between cars. Rough handling may, therefore, be considered as an inherent characteristic of heavy American rolling stock.

While it is probable that equipment, in the construction of which only thoroughly familiar materials are used, could be so designed as to effect some reduction in weight with no loss of safety, provided such equipment were not mixed in trains with that of the heavy construction, recent developments in light-weight structural materials offer the possibility of large decreases in weight without necessarily reducing the strength of the car structure at all. This means an increase in safety proportional to the reduction in weight. Not only will equipment thus built be entirely safe for operation in trains with heavy steel equipment, but the reduced weight of such new cars will provide an increase in safety of the entire train, in case of collision, in proportion as the total weight of the train is reduced. The possibility of reducing weight without reducing strength holds forth the promise of reduced passenger-train operating costs and of a much needed decrease in the roughness of handling long passenger trains.

NEW BOOKS

SAWARD'S ANNUAL. *Published by Saward's Journal, 15 Park Row, New York. 224 pages, 6 in. by 8 in. Bound in cloth. Price, $2.50.*

The 1933 edition of Saward's Annual is the fifteenth yearly issue. It covers statistics of the coal trade for 1932, or, in the case of a few foreign details, the record for the most recent date available. It embraces also details relative to output; prices; freight rates; transportation; exports; computing tables, stokers and other details of importance to the coal man, wholesale and retail.

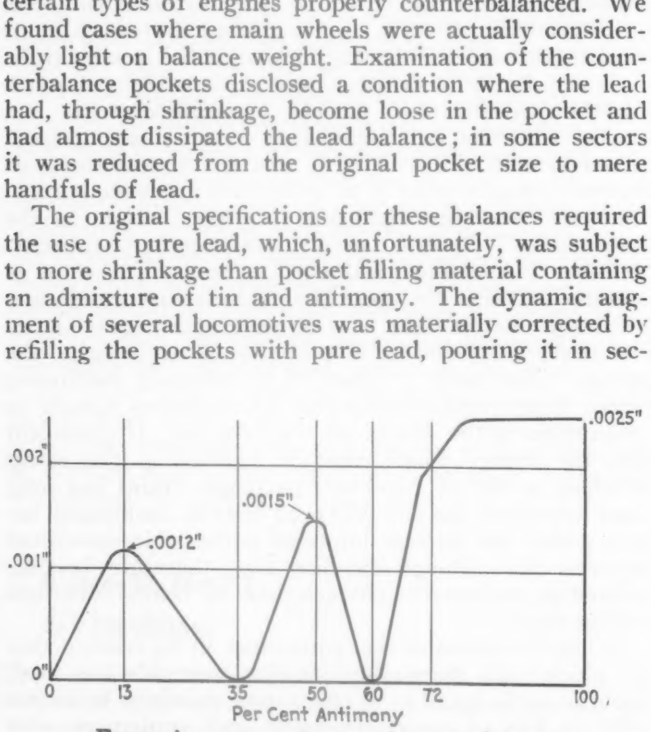
THE READER'S PAGE

Keeping Lead In Counterbalances

To The Editor:

Since the advent of heavy freight locomotives on our road we have experienced some difficulty in keeping certain types of engines properly counterbalanced. We found cases where main wheels were actually considerably light on balance weight. Examination of the counterbalance pockets disclosed a condition where the lead had, through shrinkage, become loose in the pocket and had almost dissipated the lead balance; in some sectors it was reduced from the original pocket size to mere handfuls of lead.

The original specifications for these balances required the use of pure lead, which, unfortunately, was subject to more shrinkage than pocket filling material containing an admixture of tin and antimony. The dynamic augment of several locomotives was materially corrected by refilling the pockets with pure lead, pouring it in sections and tamping in with an air hammer as the filling progressed. By this method we were able to introduce over 100 lb. more lead in the balance pockets of a main wheel.



Expansion curve—lead-antimony mixtures

While we were experimenting with several methods of correcting this counterbalancing trouble some one advanced the theory that if we were to use a mixture of lead with a certain proportion of antimony, which has the property of expanding as it cools, we might hold the balance filling weights tight in the pockets. However, we found that the expansive properties of antimony are rather erratic depending on the percentage of antimony in the mixture. With the thought that other readers of the *Railway Mechanical Engineer* may be interested in this subject I am including with this letter a chart showing the expansion curve of lead-antimony mixtures. This chart would indicate that a mixture of 13 per cent antimony and 87 per cent lead would produce about the same results as a 50/50 mixture and also would indicate that a mixture containing 35 per cent antimony would be no better than lead alone. In view of the fact that the materials used for counterbalancing are not always of a nature the exact proportions of which can be accurately controlled we could not definitely determine whether we had a good mixture or a poor one.

This problem of keeping counterbalancing materials in the pockets has been a perplexing one at times and while we feel that we have made some progress it is also possible that some other reader may have found a better way to do the job and would be willing to submit the detail of his method for publication in your columns.

B. A. Howard.

Lighter Car Equipment

To the Editor:

I have read the editorial "Lighter Cars Coming" appearing in the April *Railway Mechanical Engineer* with a great deal of interest and certainly agree with everything that is said.

This is a question to which I have given a good deal of thought in the past three years. It is a fact that we are hauling an enormous amount of unnecessary dead weight in cars. With the exception of grain and other similar commodities, we seldom load box cars to anywhere near their capacity. It is going to be necessary that we reduce the light weight of freight and passenger cars in the future and at the same time build them safe to operate over heavy grades and sharp curves at either fast or slow speeds.

Alloy metals will have to be used—metals that will resist rust and corrosion. Many coal and other type cars have had their framing deteriorate or waste away from rust or corrosion to the point where they should not be stencilled to the capacity of their trucks, unless they are rebuilt and new framing applied.

The type of construction of cars built in the future may be such as greatly to reduce the weight, due, of course, to the fact that the science of metallurgy and the autogenous welding of parts together have progressed so greatly, and the distribution of stresses has been worked out so uniformly that many sections of metal framing can be greatly reduced. Introduction of the strain gage to develop uniform stress in fabricated structures and steel castings has done much to reduce the weights of the finished car, including the truck parts. The casting of steel has been so much improved through the introduction of the electric furnace and the fine research work that has been accomplished through the efforts of the American Foundrymen's Association and the American Society of Testing Materials that it has been possible to pour a more liquid steel into thinner and more uniform sections, thus eliminating draw or shrinkage cracks and cavities. Alloy cast steels, especially chromium-molybdenum steel, properly annealed, I believe, are going to be used considerably in the future, due to the fact that they will have a high elastic limit and will be very desirable for light sections. So much for the car body.

More development has been made in trucks in the last two or three years than for a good many years past. Flexible truck frames are now being introduced which will give the car more freedom on curves, turnouts and rough track. A great deal of study has been made of the action of springs under load at various speeds and, as a result, several types of springs and groupings have been introduced to overcome "shimmying" or synchronizing action. Truck springs have been responsible for cars jumping the track and, in many cases, derailing trains. It seems to me that the Car Construction Com-

mittee of the A. R. A. should study the merits of all recent designs of flexible trucks and, if possible, embody the good points of each of them into one acceptable design.

The Car Construction Committee, I believe, is going to be one of the most important in the Mechanical Division for some time to come on account of the necessity of reducing dead weight.

Brake levers, rods and, in fact, all parts of the brake equipment can be materially reduced in weight. The piping can be welded, eliminating all pipe fittings and the possibility of failures through the threads which often occurs.

The above refers mostly to freight cars. However, the same will generally apply to passenger cars and, in many respects, passenger cars can be more materially reduced in weight than freight cars. Why should we perpetuate the conventional type of passenger car with the high, clerestory cross section? The center of gravity can be lowered materially by lowering the roof construction. Why perpetuate the old fish-belly center sills when the lattice type can be designed to take the buffing and tensile stresses with most of the load properly carried by the side framing and plating of the car? Why perpetuate the 70-ft. coach with a seating capacity of 70 to 80 passengers when a car 60 ft. long and carrying 60 passengers would be more in keeping with recent times?

Roller bearings are going to be a necessity, and we must accept them in our progressive steps. It goes without saying that as we reduce weight of equipment and friction in the bearings and on the rails, and design the cars with the least wind resistance possible by providing streamline designs, we can naturally figure on reducing the tractive force necessary to pull the trains. Of course, it is going to be a long time before we can make some of the radical changes suggested, but I am sure that most of them are bound to come.

SUPERINTENDENT OF MOTIVE POWER.

C. P. R. Multi-Pressure Locomotive No. 8000

TO THE EDITOR:

The three papers on the multi-pressure locomotive for the Canadian Pacific published in the November and December issues of the *Railway Mechanical Engineer* are of great interest to all concerned in the development of the steam locomotive.

In the paper by Mr. Ennis it is stated (on page 496) that "following the example of the German State Railway locomotive, the cranks were spaced at approximately 120 deg. for the sake of torque uniformity. As was expected, this crank setting resulted in an uneven exhaust sound, the engine being of the compound type and having only four exhausts per revolution sounds 'lame' at low speeds, but at speeds above 15 m. p. h. the non-uniformity of the exhaust vanishes."

It is also mentioned (on page 493) that "the valve motion for the inside cylinder is derived from the two outside gears by the combined Gresley valve motion frequently used on three-cylinder locomotives in America."

Mr. Bowen states in his paper (page 498) that "proper draft adjustments and boiler conditions are somewhat more difficult to secure with locomotive No. 8000, as the exhausts are secured at uneven intervals. The uneven effects on the draft conditions of the engine are more noticeable at low speeds."

The difficulty to which Mr. Bowen refers is accentuated by the adoption of oil fuel in place of coal, and it would appear that better combustion would result from four even exhaust beats per revolution, as given by outside cranks spaced at 90 deg. apart instead of 120 deg., an arrangement adopted in three-cylinder compounds in England and Ireland. In this case the inside crank is at 135 deg. to each of the outside ones, instead of 120 deg., but the difference of 15 deg. does not greatly affect the uniformity of torque or the balancing.

It may be objected that this would necessitate a third valve motion complete in place of the Gresley arrangement of levers, which is only suitable for cranks spaced at 120 deg., but I would point out that the difficulty can be easily overcome by altering the ratios of the lever

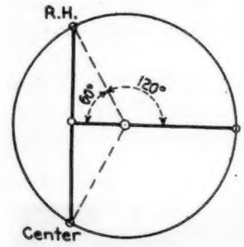


Fig. 1

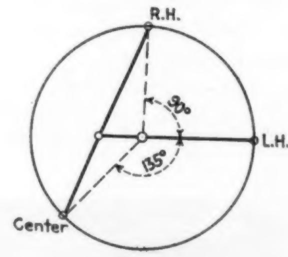


Fig. 2

arms. In my patent specifications of 1909, which anticipated to some extent Mr. Gresley's patent of 1918, it is shown that two valve motions can be combined to give a third, irrespective of the crank angles, and it is only necessary to suitably proportion the lever arms to do so.

In the case of two outside cranks at 90 deg., the usual ratios for the 120-deg. setting can be replaced by another of different proportions. This is demonstrated geometrically in the following diagrams:

Fig. 1 showing cranks (and motions) at 120 deg. apart, indicates that a floating lever having equal arms should be connected to the right-hand and center motions, while a lever with a fixed fulcrum having arms in ratio 1 to 0.5 (cosine 60 deg.) should be connected to the left-hand motion and middle point of the floating lever.

Fig. 2, showing outside cranks at 90 deg., indicates that an alteration to the proportions of both levers is required. These ratios can be ascertained by setting the figure out on paper and measuring the ratios. Actually, these are 1 to 0.707 (cosine 45 deg.) for the floating lever and 1 to 0.414 (cosine 45 deg. divided by 1 plus cosine 45 deg.) for the fixed lever.

If then, as the result of experience, it is found that even exhausts are of greater importance than torque and balancing, it would be a comparatively easy matter to alter the outside cranks of No. 8000 to 90 deg. and provide new combination levers for the middle valve having ratios to produce the required travel at an angularity of 135 deg.

H. HOLCROFT,
Surrey, England.

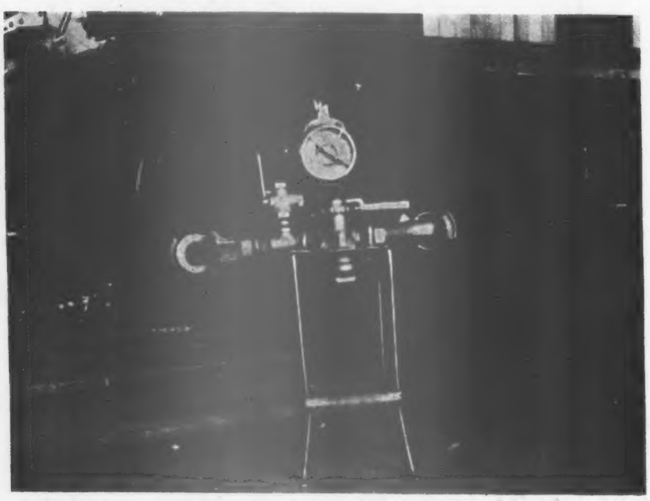
SUPER-SMOOTH HANDLING.—Engine service employees of the Baltimore & Ohio around Akron Junction, Ohio, recently demonstrated in a startling way their ability to handle trains—even of coal cars—smoothly. It seems that a car of coal was placed in the siding of the M. A. Knight Company, about three miles from Akron Junction. While the car was being unloaded, an employee of the companyy removed his spectacles and placed them on the top of the car. During the process of the car's unloading, he forgot all about them, and before he discovered his loss the car had been switched to Akron Junction and placed in Hill Yard preparatory to further movement. There the glasses were found intact, on top of the car, and they had not even shifted their position.

With the
Car Foremen and Inspectors

Portable Stand For Single-Car Testing Device

THE single car testing device shown in the illustration is equipped with a stand to eliminate the necessity of the air-brake inspector getting down on his knees to make the necessary reductions and tests while watching the test gage.

The stand consists of four pieces of $\frac{5}{8}$-in., round iron 14 in., long. A $\frac{1}{8}$-in. plate cut out in the center to permit the base of the device to have a proper seat is welded



This stand saves the inspector's back and keeps dirt out of the brake pipe

to the top of the legs and four pieces of $\frac{3}{8}$-in. by 1-in. wrought iron are welded on the legs about four inches from the bottom to make the stand rigid.

The use of this stand not only prevents a great deal of unnecessary bending on the part of the inspector but keeps the testing device out of the dirt and cinders, which are liable to be blown into the train line of the car while making the test.

Interchange Rule 73 Misundertood

INTERCHANGE Rule 73 reads as follows, the italicized portion having been added as the result of a recommendation by the Committee on Wheels in letter ballot Circular DV-764, dated May 13, 1932:

"Rule 73. Worn through chill: See Par. 102 and 103 and Fig. 76 in the Wheel and Axle Manual for identification of this defect. *Wheel shall not be removed from service if tread is not out of round in excess of $\frac{1}{16}$ in. within an arc of 12 in. or less.* Care shall be taken to distinguish this defect from flat spots caused by sliding wheels.

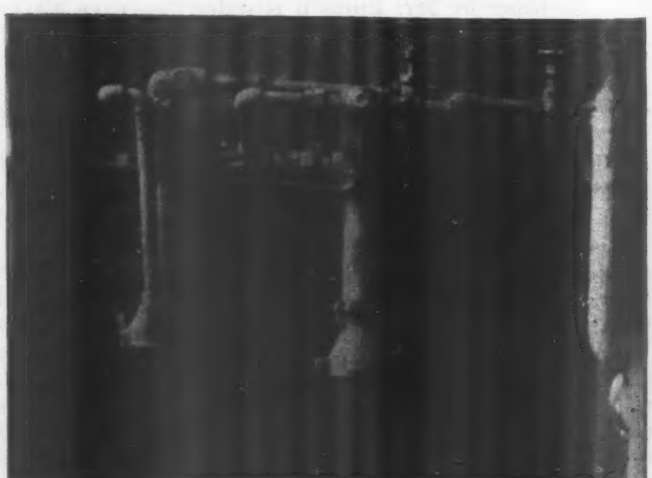
"Note.—The Committee on Wheels has ruled that a satisfactory type of gage for use in connection with this requirement is a gage with two contact points on an arc of 12 in. of a standard 33-in. wheel on a radius of $16\frac{1}{2}$ in., with a midway contact point on a radius of $16\frac{7}{16}$ in. It should be borne in mind that the rule specifies an arc of 12 in. and not a 12-in. chord."

According to an announcement recently issued by V. R. Hawthorne, secretary of the American Railway Association, Mechanical Division, the application of the revised rule was discussed at recent meetings of the Committee on Wheels and the Arbitration Committee whose investigation has developed that there is a misunderstanding in reference to the use of the gage therein specified.

The modification of this rule in 1932 was intended to correct the wholesale removal of wheels at certain points on the basis of judgment alone, and the second sentence was added to restrict the removal of wheels as worn-through-chill to wheels which gave indication of being worn-through-chill (as described and defined in Par. 102 and 103 of the Wheel and Axle Manual) and, in addition thereto, were in excess of $\frac{1}{16}$ in. out of round within an arc of 12 in. or less. It was not intended that this sentence should be construed as authority to remove wheels simply because they are out of round, but that this provision would be an added safeguard to prevent the removal of worn-through-chill when the worn-through-chill defect (as described in the Wheel and Axle Manual) does not exist.

Testing Regulator Diaphragm

A METHOD of testing Vapor heat-regulator diaphragms before scrapping them is shown in the illustration. Two regulator valves are mounted on the wall of a shed adjoining the car repair shop at a large

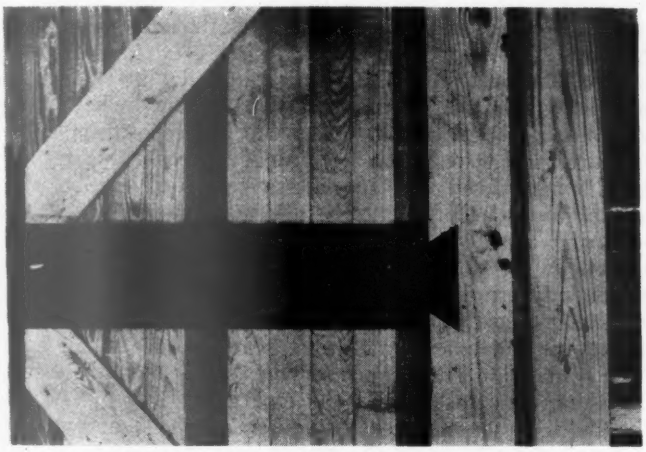


Device for testing diaphragms of heat-regulator valves

terminal, one valve being used for testing nickel-plated No. 530-Z diaphragms and one for No. 440 heat-regulator valves. It is found that many diaphragms removed by car-repair men from passing cars are in perfect condition and can be returned to stock instead of scrapped. Whenever a barrel of these diaphragms is collected, it is relatively simple to test them on this rack and scrap only those which are defective.

Mortising Box-Car Door Members

TO obtain greater rigidity in the side doors of box cars one railroad has adopted the method as shown in the photograph. Since all battens are fabricated in the mill before being sent to the door bench for assembly the extra cutting takes no more time than other methods.



Mortising the door battens in this manner helps keep them tight

Tests have shown that by employing this method of mortising the doors do not begin to loosen or get out of square after being in use for a few months and that it will prevent cracks from developing between the sheathing provided, of course, that seasoned lumber is used in renewals or repairs.

Katy Air-Brake Repairs Centralized

*By W. E. Vergan**

THE successful operation of a railroad is absolutely dependent on the ability to control heavy trains smoothly at high speeds. The modern air brake accomplishes this automatically and is, therefore, the means by which fast schedules and heavy trains are made possible. It is the backbone of railroading. The ability to stop, when and how desired, is even more important than the ability to start. It is for this reason that the government prescribes a definite period of time for which the various air-brake devices may stay in service, when they must then be removed, repaired, tested and again made ready for service.

The repairing of air-brake devices requires the services of specially trained men, working under proper supervision. It requires special tools, jigs, machinery and test racks in order to insure proper repairs. Each man must be highly skilled in the operation which he performs. Centralization of this work has brought about a decided saving in the cost of repairs, having greatly improved the character of work done, as shown by the decided decrease in the number of slid-flat wheels, brake-burned wheels, break-in-two's, damage to lading and equipment, number of wrecks and cases of rough train handling. Centralization also tends to place all of the work under competent supervision at one centralized air-brake shop as, for example, at the Parsons, Kans., shop of the M-K-T lines, rather than at 16 small shop points, as heretofore.

Bad-order, or out-dated, air-brake devices are delivered to the Parsons air-brake shop by the stores department by means of an elevator, the air-brake department being on the second floor. The devices are then removed from their shipping boxes and placed in holding racks to await dismantling. The dismantling benches are located at one side of the air room. It is at these benches that all of the devices are stripped and their parts put in metal baskets and placed in the cleaning vats, located directly behind the man on the left of the picture. The baskets are left in the cleaning solution until all of the parts are thoroughly cleaned, when they are immersed in a tank of clean warm water to rinse off the cleaning solution. All of the cast-iron

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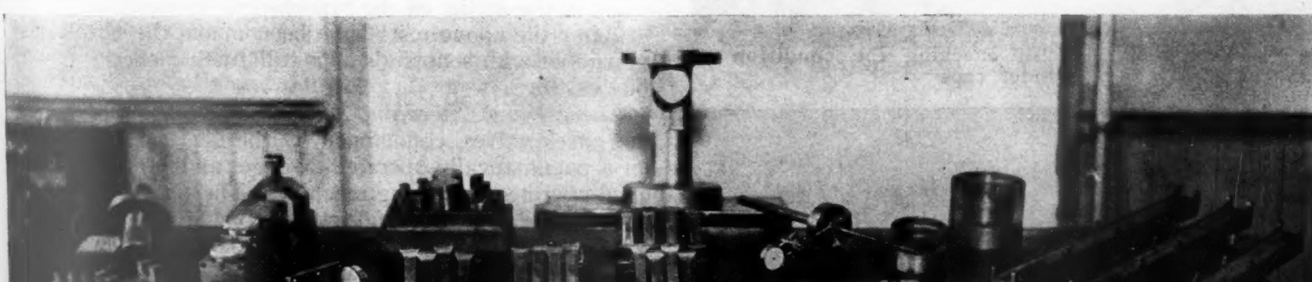


Fig. 1—Some of the wear-limit and other gages used in testing air-brake parts

Fig. 2—Preliminary check-valve testing device

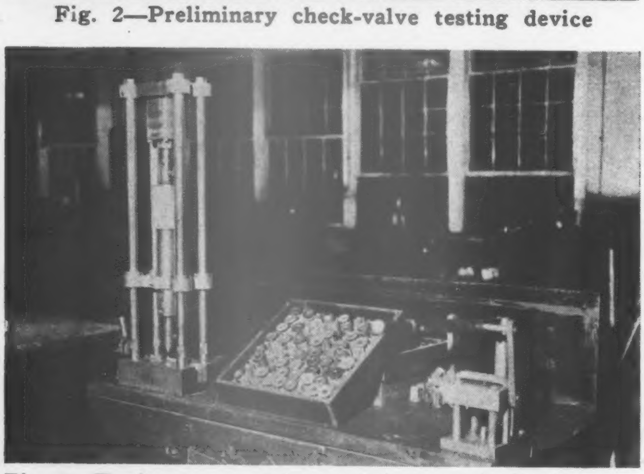


Fig. 3—Equipment used in swedging and broaching bad-order check valves

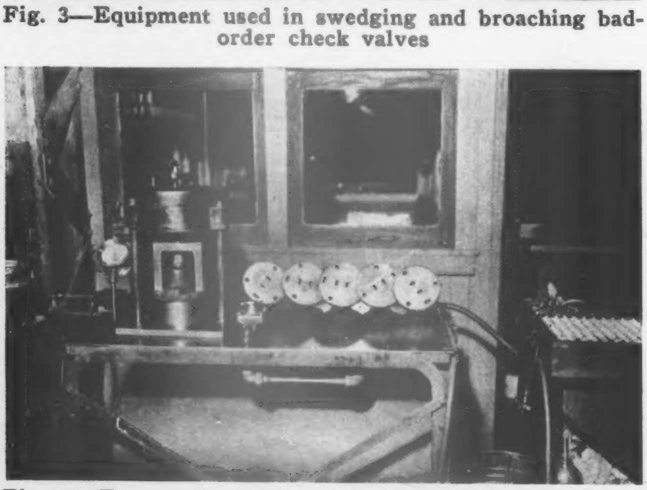


Fig. 4—Test rack used in checking the condition of cylinder caps

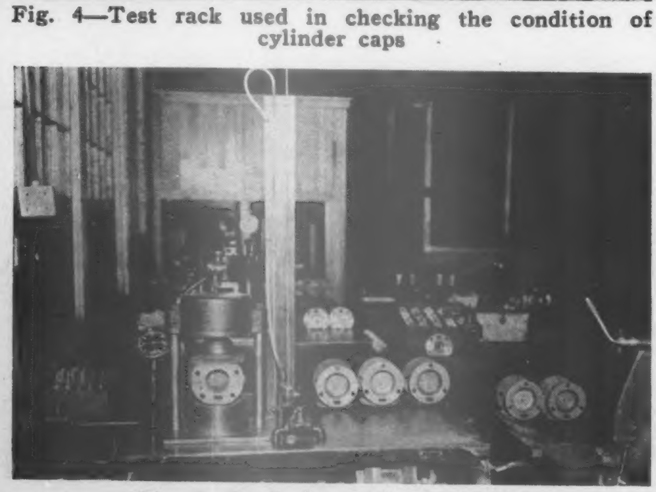


Fig. 5—Preliminary ring test rack

bodies, caps and covers, are then "soaked" in a paraffin bath in order to fill up any pores in the castings and to insure against the possibility of rusting. The brass parts are dipped into an acid bath and thoroughly cleaned.

After passing the cleaning process, the parts move to the gaging bench where the parts are accurately gaged. All parts failing to pass the gages are sent to the various machines where their dimensions are brought back to standard. Some of the gages used on this bench are shown in Fig. 1. The devices and their parts then move in special trays forward to the department in which they will be repaired. As all of the devices are routed through the repair operations in the same line of progression, the routing of freight-car triple valves may be considered typical.

Each part of the triple valve, after being inspected or repaired, is tested separately on a preliminary test rack, thus assuring that part to be in good order before the triple valve is assembled for the final test. This eliminates the necessity of again dismantling the triple valve in order to replace some part that failed to pass the final test.

The triple-valve check cases are placed in trays and delivered to the check-case department, where the check valve is ground in. The check case is fitted with its parts and tested on a preliminary check-valve tester, then being placed in a special tray and delivered to the assembling bench.

Preliminary Check-Valve Tester.—On this test rack, shown in Fig. 2, the complete check case, including the check valve and emergency valve and seat are tested. The check case is clamped to a block which is recessed to receive the emergency valve seat. There is an air-hose connection from the reservoir to this block between the emergency piston and the emergency valve. After the check valve has been ground in on the bench at the right of the test rack, the check case is completely assembled and clamped in the test rack. The air-hose connection is made to the branch pipe opening of the check case and air is admitted underneath the check valve and on top of the emergency valve. Any leakage past the emergency valve is measured by placing the leakage-indicator fitting in the ¼-in. drain cock directly at the right of the clamp. No leakage is allowed.

After the emergency valve has been tested, the air-hose connection is broken at the check case and a leakage-indicator fitting is screwed on in its place. Air is then admitted on top of the check valve and the check-valve leakage measured by placing the hose of the leakage indicator in the fitting on the branch-pipe opening.

After the above tests have been made, the check case is painted with soap suds as a still further check on porous castings.

Check-Valve Swedging and Broaching.—All bad-order check valves, condemned by the gages, are swedged on a pneumatically-operated swedge, and broached on a hand-operated broaching machine. These two operations insure that the wings of the check valve are of the correct dimension and that they are concentric with the emergency-valve-spring hole.

The swedging machine, shown at the left in Fig. 3, is of automatic, quick-trip design, operated by compressed air. The check valve is inserted at the base and rests on the lower die, air then being admitted to the small air cylinder at the top. As the piston moves downward, the top die is brought into contact with the check valve, and, as the piston continues, a light spring is compressed which alines the check valve on the lower die.

The lower die is made in two pieces and can swivel on the base. This is necessary because of the fact that the

wings on all of the valves do not have the same taper nor are they of the same thickness.

As the piston moves on down, a heavy spring is compressed until a certain point is reached when the spring is released and the blow delivered. The force of the blow can be altered by loosening or tightening the top cap. The movement of the swedge is about ¼ in. and the movement of the barrel is about 2 in.

After the check valves have been swedged, they are broached on the hand broach shown on the right of the bench. The check valve is placed over a pin in the base and the handle brought downward. A circular broach is inserted in the heavy block on top and, as it is brought downward, it broaches the wings of the valve to the correct dimensions. This method insures that all of the wings of the valve will be the same distance from the axis of the spring hole. This is an important point of alinement in the check case.

Only a slight downward pressure need be exerted on the handle of the broach. The seat of the valve is then machined and the valve is sent, together with other reclaimed valves, in special trays to the check-case bench.

Testing Cylinder Caps.—The test rack for this purpose, shown in Fig. 4, comprises a pneumatic cylinder and quick-clamping devices for holding the cylinder cap firmly against the gasket and false seat while the test is being made.

The operations, here performed, consist of applying a newly machined graduating stem and a standard graduating spring to the cylinder cap. The assembled cylinder cap is then tested for leakage, as indicated by the gage, placed in a tray and delivered to the assembling bench. Retarding devices are also repaired at this bench along with the emergency valve brass seats which require reconditioning.

After the triple-valve body is cleaned, it is gaged, and, if the main piston bushing is found to be more than .001 in. out of round or tapered, the bushing is ground true and fitted with a new ring. It is then tested on a preliminary ring test rack.

Preliminary Ring Test Rack.—This test rack, illustrated in Fig. 5, utilizes a mercury tube, one end of which is connected to the atmosphere and the other end connected to the brake-pipe side of the triple piston. Air is admitted to the brake-pipe side of the piston through a small orifice choke and a 90-cu. in. reservoir. A pressure of 24 lb. is maintained in the main reservoir.

The ring leakage is measured by the distance the column of mercury on the left drops. The greater the ring leakage, the less will the mercury drop. The air flowing to the small reservoir and then to the triple piston is governed by a small orifice, so if the ring is perfect the mercury will drop a distance equivalent to the 24-lb. pressure on top of the column. However, if the ring leaks, there will not be as much pressure on top of the mercury and it will not drop as far. The column is calibrated to read the lb. per sq. in. leakage equivalent to the leakage test on the 3-T triple-valve test rack.

Testing a ring in this manner eliminates the chance of the 3-T test rack rejecting the triple valve on account of a leaking ring. This eliminates, as do the other preliminary test racks, the necessity of dismantling a triple valve after it has gone to the 3-T test rack.

After passing the ring test, the triple-valve body is placed in a small 4-wheel, sheet-metal car, large enough to hold five valves, and sent down the triple-valve conveyor, located between the work benches and the windows, to the slide-valve department. After the car is emptied, it is sent back on a lower rail for another load of triples. There are three sets of these conveyors. One set extends from the piston-ring department to the slide-

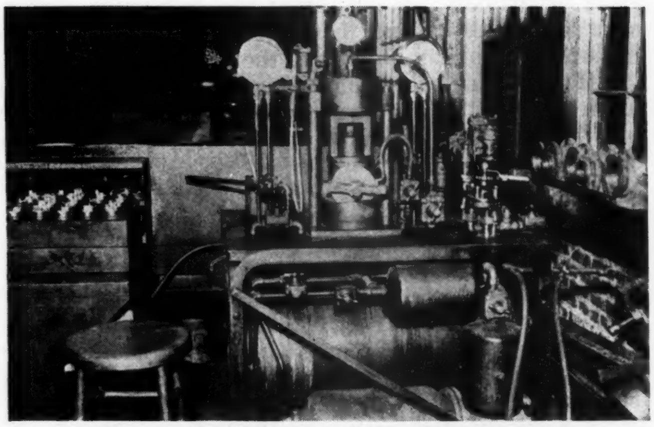


Fig. 6—Preliminary slide-valve test rack

Fig. 7—Universal valve-repairing department

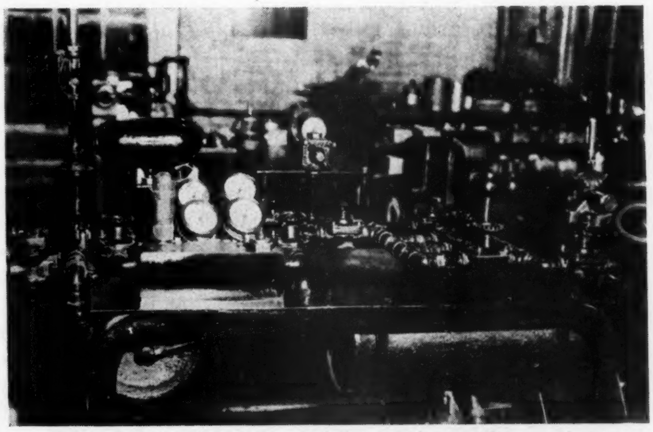


Fig. 8—Equipment used in testing safety valves

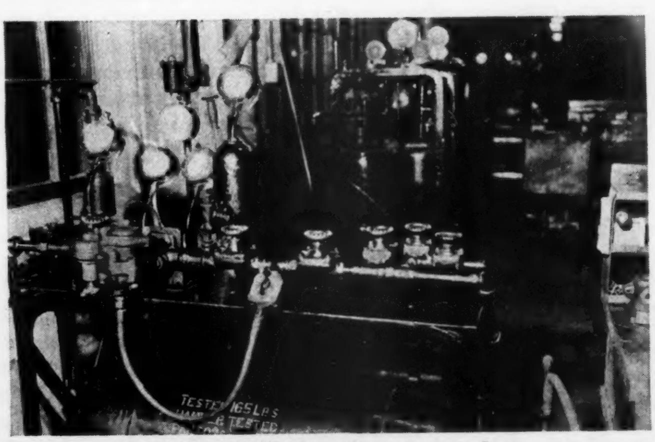


Fig. 9—Feed-valve test rack

valve department, another from the slide-valve department to the assembling benches, and another extends from the assembling benches to the 3-T test racks.

After the slide valves and graduating valves have been repaired, the retarding device is applied to the triple valve and the valve clamped in a preliminary slide-valve test rack.

Preliminary Slide-Valve Test Rack.—On this rack, shown in Fig. 6, the slide valve and graduating valve are tested, as is the charging rate of the triple valve and the release test.

The rack is a modified 3-T test rack. The clamping device carries a regular cylinder cap with a brake-pipe hose connection which supplies air to the brake-pipe side of the triple piston and charges the auxiliary reservoir in the usual manner. The triple valve is clamped, as shown, and a blanking plate with a quick-service port registration is clamped over the check-valve-case opening. The brake cylinder and auxiliary reservoir connections are made in the bottom plate.

The triple valve is charged and the slide valve and the graduating valve are tested in the same manner as on the 3-T test rack and using the same code of tests.

The test rack is equipped with a slow application and a slow release test enabling the operator to locate long feed-groove conditions. The regular 3-T brake valve *A* is used, but valve *R* has been eliminated. The quick-recharge feature has been retained, however, by means of a diaphragm cock providing a by-pass from the brake pipe to the auxiliary reservoir.

After passing this test rack, the triple valve is placed on the conveyor and sent to the assembling bench. Here the triple valve is completely assembled, placed on the conveyor and sent to the test racks. The final test rack is the standard A. R. A. 3-T triple-valve test rack. Here the triple valve is tested as a whole and then sent to the capping bench, where all openings are plugged and capped in order to prevent dirt and water from entering the triple valve during shipment. The triple valve is then placed on a truck and is ready to go back into the storeroom stock.

All freight triple valves, passenger triple valves, locomotive triple valves, locomotive vent valves and locomotive distributing valves follow this same line of routing through this department. The remainder of the air-brake devices are repaired in specialized departments, such as the air-compressor department; the universal valve department, shown in Fig. 7; the safety valve department, shown in Fig. 8; the feed-valve department, shown in Fig. 9; brake valves, brake application valves, pilot cutoff valves, etc. Numerous other test racks, not illustrated in the present article, are provided for testing single car testers, air gages, retainer valves, release valves, pump governors, steam-heat regulators, signal valves, caboose valves, water-raising governors and reducing valves.

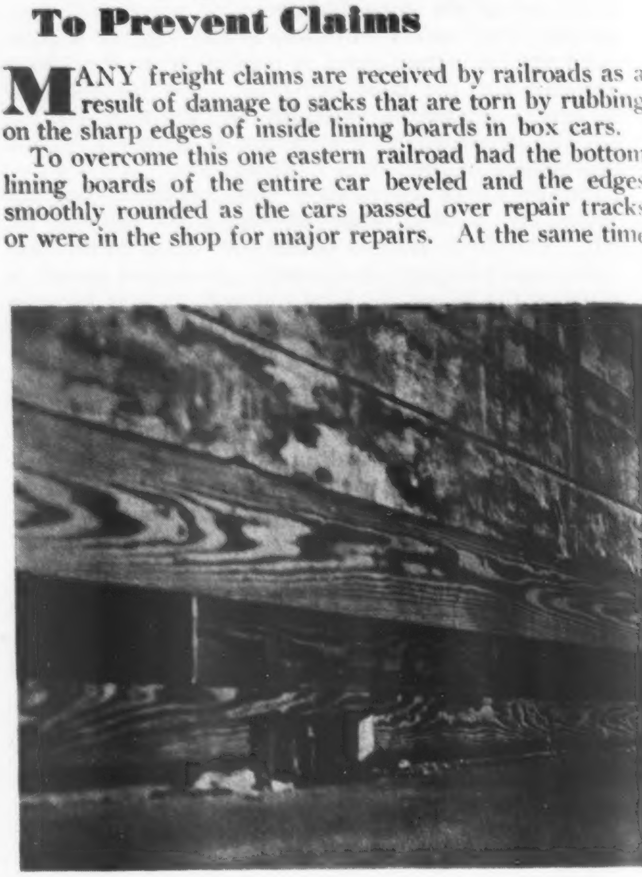
Except for the 3-T test rack and the universal-valve test rack, all of the test racks, tools and labor-saving devices, mentioned, have been developed and built in the Parsons air-brake department.

When Horses Were Railroad Equipment.—Horses were once a necessary part of railroad equipment. Back in 1838, one of the pioneer lines then in operation insisted upon the use of horses in some of its operating rules. For instance, one of the rules read: "When anything shall happen to a train to render assistance necessary, let a brakeman be dispatched to the nearest point of assistance and let him get on horseback as soon as possible." Another rule stipulated: "If at any time a train should not arrive at either depot in one hour from the time of its starting from the other, the master of the depot will immediately start on horseback to learn the cause of the delay."

Beveling Lining Boards To Prevent Claims

MANY freight claims are received by railroads as a result of damage to sacks that are torn by rubbing on the sharp edges of inside lining boards in box cars.

To overcome this one eastern railroad had the bottom lining boards of the entire car beveled and the edges smoothly rounded as the cars passed over repair tracks or were in the shop for major repairs. At the same time



The beveled and rounded edges of the lining boards prevent the tearing of sacks

the inside belt rail boards and the door post protection strips were also beveled and smoothed. All bolt heads were countersunk and nails removed to prevent similar damage. The method of beveling the bottom lining boards is shown in the accompanying illustration.

Decisions of Arbitration Cases

(The Arbitration Committee of the A. R. A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Substitution of Truck Sides Claimed Improper Repairs

On August 7, 1929, the Illinois Central repaired Chicago & North Western car No. 137,722 at Clinton shops and submitted a repair bill supported by a billing repair card showing the application of two second-hand Vulcan truck sides and four Vulcan journal boxes, with certain related truck parts, in place of Scullin truck sides and journal boxes, and certain related parts. The C. & N. W. requested cancellation of the entire repair charge because the I. C. did not apply a defect card at the time the repairs were made and contended that the billing repair card is evidence of and in itself shows wrong repairs made; therefore, Interpretation 4, Rule 87, in Sup-

plement 1 to the 1929 Code (present fourth paragraph of Rule 87) applies. The I. C. contended that its repair card did not establish improper repairs within the intent of the rules, and if these repairs were improper as alleged, claim should have been made in accordance with A. R. A. Rules 12 and 13. It further contended that adjustment was not due in this case because, although the billing repair card showed a truck side of one manufacturer removed and replaced by another make, it did not necessarily prove that improper repairs were made.

The following decision was rendered November 4, 1932: "The repair card of the Illinois Central shows Vulcan truck sides applied in place of Scullin, with necessary change in type of oil boxes and spring plank. It shows also spring plank bolts applied in place of rivets. It is considered that this information is conclusive evidence of making wrong repairs and the Illinois Central should have attached its defect card at the time of making the repairs. Having failed to do so, it is optional on the part of the owner to require cancellation of the charge under the provisions of Rule 87. The contention of the C. & N. W. is sustained.—*Case No. 1706, Chicago & North Western vs. Illinois Central.*

Car Damaged When Train Ran Through an Open Switch

Western Fruit Express refrigerator car No. 49284, of all wood construction with metal draft arms, was damaged while being handled on the Pennsylvania at Cresson, Pa., November 8, 1930, and disposition requested under Rule 120, because of damage amounting to an estimated total of $1,565.07. The car in question was empty at the time the damage occurred and was the seventeenth car in a train of 100 cars moving east on a running track through Cresson yard en route to Altoona. There were two locomotives ahead and two at the rear end. The air line was coupled up throughout the train, including the two rear-end locomotives. As the train proceeded from Cresson yard at a speed of 12 miles an hour, the head end passed through an open switch and when the head engineman realized the situation, he immediately made a service application, bringing the train to a sudden stop resulting in W.F.E.X. car No. 49284 buckling and breaking in two near the center of the car. The accident caused telescoping damage to the "A" end of Pennsylvania car No. 695430, a 140,000 lb. capacity steel hopper loaded with coal, which was the sixteenth car in the train. Both cars were moved to a shop siding on their own trucks, and when the P.R.R. car was pulled away six days later the damaged end of W.F.E.X. 49284 settled to the ground. The car was then picked up by a derrick and set off on the ground to clear the track, during which handling the car collapsed. The owner's representative inspected the car and agreed at the time that the refrigerator car was not telescoped as defined under the rules in effect. As the car owner did not furnish disposition within the 30-day time limit of Rule 120C, the Pennsylvania dismantled the car. The latter company stated that the refrigerator car was not derailed nor subject to any other condition of Rule 32 and contended that the car owner was responsible in accordance with Rules 43, 44 and 120. The Western Fruit Express in its statement contended that the Pennsylvania, through negligence on the part of a yard switching crew in leaving the switch open and in rough handling, was responsible for damage to the car which showed no evidence of weak construction, and that the Pennsylvania should be held responsible as the damage was the direct result of the train being brought to a sudden stop after running through a switch. It further contended that this case could not be considered ordinary handling as it properly comes under the heading of "Misplaced Switches" explicitly mentioned in Section (d) of Rule 32. The Pennsylvania contended that the distance of six or seven car lengths that the head end of the train proceeded beyond the switch is immaterial in this case inasmuch as the car in question was the seventeenth in the train and did not pass the switch. The damage, according to the statement of the Pennsylvania, was due not to the position of the switch, but to the slack running in from the rear end in connection with an ordinary service application of air brakes by the enginemen on the head locomotive. The contention of the Pennsylvania was that the car failed in fair service and that the owner is responsible.

The Arbitration Committee in a decision rendered November 4, 1932, said: "The direct cause of damage to this car was the result of application of air brakes from the engine cab. No Rule 32 condition is involved. Therefore, the contention of the Pennsylvania is sustained."—*Case 1708, Western Fruit Express vs. Pennsylvania.*

Rule 12—Improper Repairs Made by Foreign Roads

On March 29, 1930, the Chicago & Alton applied a pair of second-hand wheels to Pacific Fruit Express refrigerator car No. 8346, such wheels being reported to have been mounted on a second-hand A.R.A. axle and the charge for the wheels and the axles included in the C. & A. bill. These same wheels were subsequently removed from the car because of a chipped rim by the Cleveland, Cincinnati, Chicago & St. Louis at Riverside, Ohio, on June 11, 1931, at which time the axle was shown to be a non-A.R.A. axle because of a center diameter of 4⅝ in. The Pacific Fruit Express endeavored through correspondence to show that the responsibility for the application of the non-standard axle rested with the C. & A. and that, inasmuch as no adjustment was made at the time of application of the non-standard axle as provided in the A.R.A. rules, adjustment should be made by means of counter-billing authority. The C. & A. declined to do this regardless of the fact that the Big Four repair card, taken at a later date, showed the axle to be non-standard and, therefore, scrap. The C. & A. in its statement called attention to the fact that whereas the center of car axles ordinarily are subject to very little wear, this seemed to be a case where wear at the center was involved and contended that an interpretation of Rule 85 indicated owner's responsibility for wear on an axle at the center due to a brake chain or brake rod. It further called attention to the fact that under its repair track practice it was quite improbable that the axle would have passed several inspectors had it been a non-A.R.A. center diameter. The Big Four in its statement recorded the center axle measurement as 4⅝ in. and said that all wheels and axles removed from equipment are given a very careful final inspection and gaging when they come through the wheel and axle shop to determine their suitability for further service as prescribed by the limits set up in the rules.

The Arbitration Committee rendered the following decision on November 4, 1932: "The car owner failed to obtain joint evidence within 90 days after the first receipt of the car home as required by Rule 12, fifth paragraph. The contention of the Pacific Fruit Express is not sustained. Decisions 1167, 1270 and 1361 apply." —*Case No. 1709, Pacific Fruit Express vs. Chicago & Alton.*

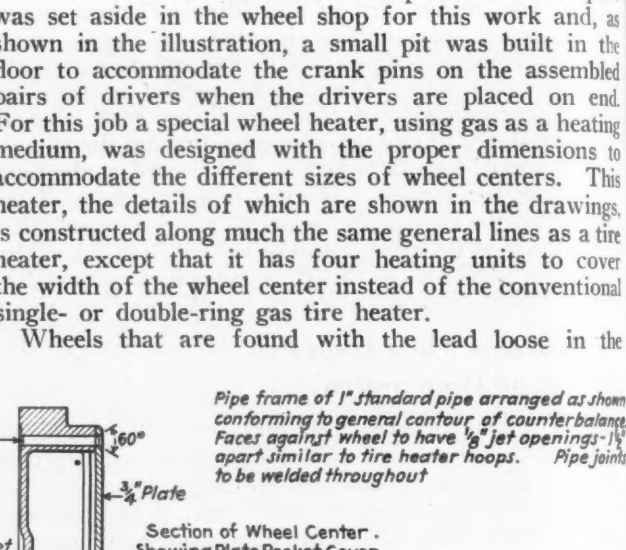
In the Back Shop and Enginehouse

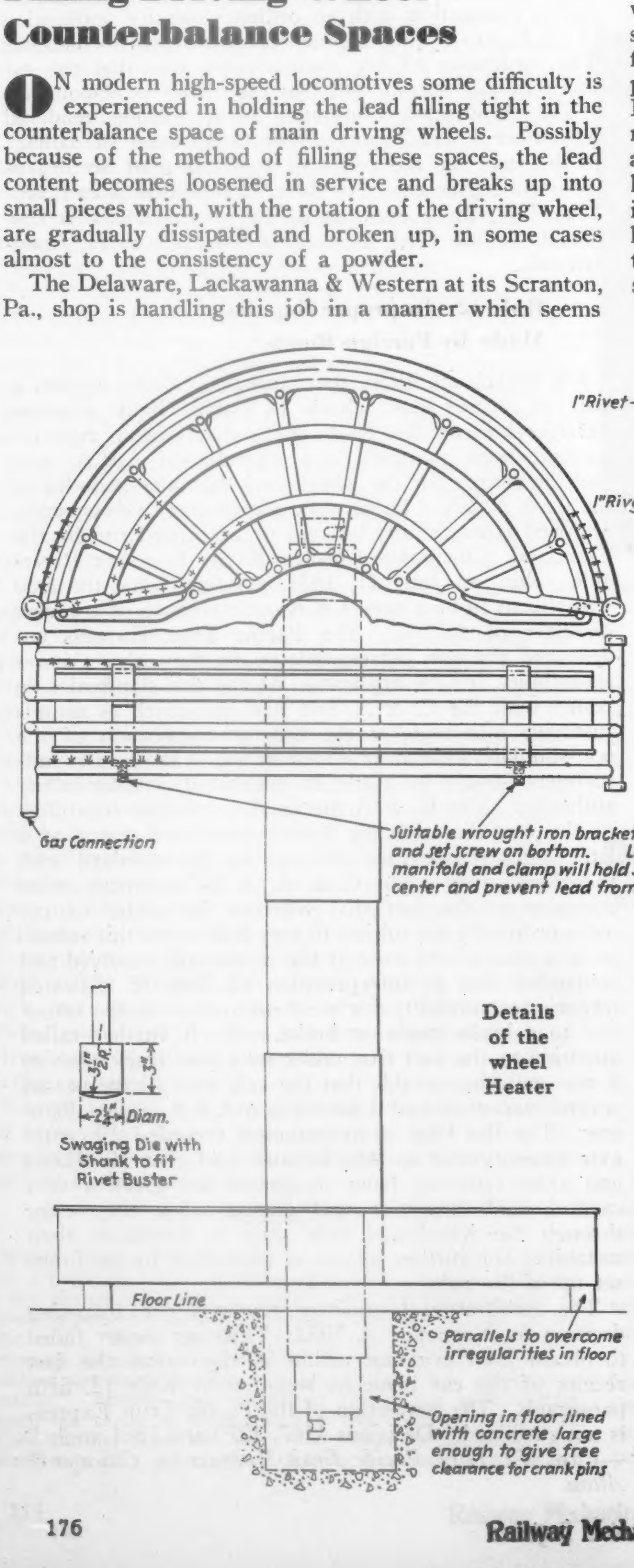
Filling Driving-Wheel Counterbalance Spaces

ON modern high-speed locomotives some difficulty is experienced in holding the lead filling tight in the counterbalance space of main driving wheels. Possibly because of the method of filling these spaces, the lead content becomes loosened in service and breaks up into small pieces which, with the rotation of the driving wheel, are gradually dissipated and broken up, in some cases almost to the consistency of a powder.

The Delaware, Lackawanna & Western at its Scranton, Pa., shop is handling this job in a manner which seems to have overcome the difficulties experienced. A space was set aside in the wheel shop for this work and, as shown in the illustration, a small pit was built in the floor to accommodate the crank pins on the assembled pairs of drivers when the drivers are placed on end. For this job a special wheel heater, using gas as a heating medium, was designed with the proper dimensions to accommodate the different sizes of wheel centers. This heater, the details of which are shown in the drawings, is constructed along much the same general lines as a tire heater, except that it has four heating units to cover the width of the wheel center instead of the conventional single- or double-ring gas tire heater.

Wheels that are found with the lead loose in the counterbalance have the outside cover plate of the balance removed, the wheel set up in a vertical position approximately level, and a form made of 1-in. square iron. The shape of the balance is placed in position and clamped. The point of contact of this form and the balance is cemented with asbestos, mixed to a plaster consistency, to prevent loss of molten lead. The heater is applied and started, heating the balance section of the wheel and at the same time starting to melt the old lead which is still in the balance. Cold pig lead is laid in the pockets and melted down by the heater, the heating and melting being done in one operation. This takes about 2 or 2½ hours. As the mass of lead in the pocket is brought to a liquid state, all dross and foreign matter floats to the top and is skimmed off. Sufficient pig lead is added to bring the level of the lead up even with the top of the shroud or from ½ in. to ¾ in. above the surface of the balance pocket. The heater is left on only long enough to bring the lead to a liquid state and then the gas is turned off. The wheel is now allowed to cool (still being in an upright position) and when the lead and the wheel center have been entirely cooled, the heater and the





Details of the wheel Heater

form are removed (still leaving the wheel in an upright position). The man assigned to this work uses a rivet buster with a special die to pound the lead into the wheel pocket. The workman has a splendid opportunity to apply the full blow of the rivet buster on the lead as he stands on top of the wheel and the blow is downward. After this operation has been completed on both wheels, the mounted wheels are set up on a planer or drawcut shaper and the excess lead is machined off from the face of the balance. The cover plate is then fastened on with rivets or tap bolts (depending on the wheel-center design) and the cover plate is electrically welded to the wheel center around its entire edge.

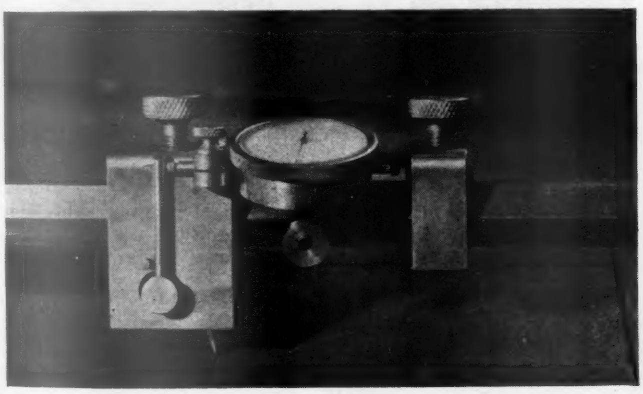
In the case of new wheels, the heater is applied to the wheel center before mounting on the axle and the pig lead is placed in the pockets and gradually melted down. When melted, the dross is skimmed off and the wheel allowed to cool. After the lead is tamped into place with the rivet buster, the new wheel center is started through the regular machine process on a boring mill.

A Tram Gage Comparator

By R. B. Loveland

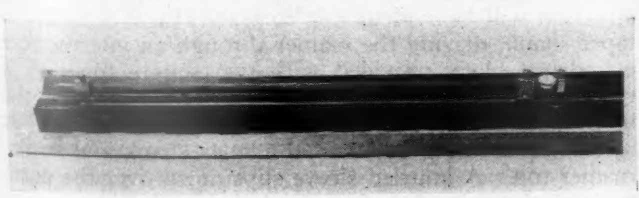
IN checking main- and side-rod master tram check gages, the gaging must be very accurate. The comparator shown in the accompanying photograph answers the purpose satisfactorily. It consists of two bars of ⅞-in. hexagon steel; one bar long enough for side rods, and one for main rods.

On one end of the bar there is a slide with a hardened



The comparator dial test indicator arrangement

and ground center screwed into it and a set screw to hold it in place. A head, which has a dial test indicator, is placed on the other end of the bar. This head has a



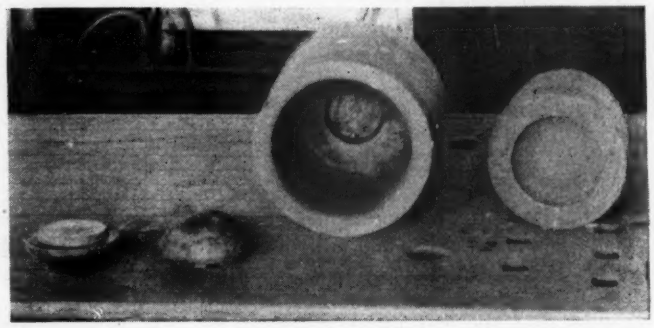
The assembled comparator.

movable slide with a hardened and ground center screwed into it. There is a pin in the movable slide which engages the dial indicator. In the back of the head is a set screw which engages the slide and holds it after it has been set with the master scale.

To check the gages, the comparator is first set for the length of the tram to be checked on the master scale. The comparator is then placed on the gage with the test indicator dial set at zero and the set screw tightened. Then to re-check with the master scale, the set screw is relieved, and the dial indicator will show in thousandths of an inch how much the gage is out.

Two Forging Operations

TWO interesting forging operations, carried on at the Battle Creek (Mich.) shops of the Grand Trunk Western, are illustrated. Union link collars for crosshead pins, for example, are forged in one heat un-



Main die (with center plug inserted) and male portion with hemispherical recess, used in forging half balls for trailer yokes

der a steam hammer using the die shown in one of the illustrations. This die is made of axle steel and comprises a main cylindrical block, machine recessed as shown, a circular flange cover plate, a punch and a plug which fit the center hole in the bottom of the main die.

The blanks consist of 21-lb., 4-in. round stock, 6½ in. long, and are heated to 2,000 deg. F. As each is

Main die, cover plate, punch and plug used in forging the union link collar shown at the left

taken from the furnace, it is placed on end in the die which rests in a vertical position on the anvil block under the steam hammer. The hole in the bottom of the die is, of course, filled with the plug. Operation of the hammer forces the excess stock to fill the die flush with the top. The cover plate is then placed on the die and the punch inserted in the center hole. Operation of the

hammer then punches a hole through the center of the forging, pushing the plug out of the bottom of the die ahead of the excess stock. The die is then turned over and the completed forging forced out.

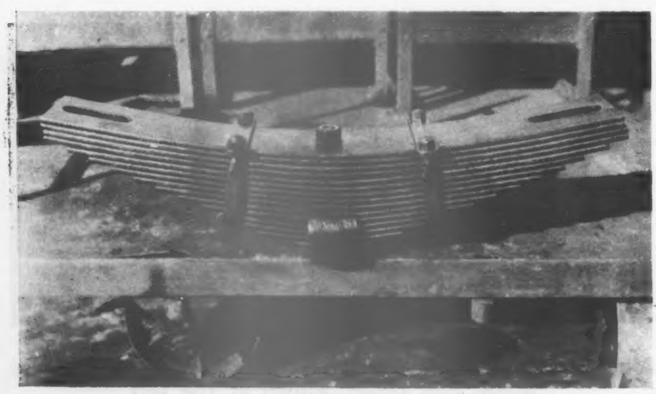
By this method a forged collar of superior physical properties is secured, owing to the working of the steel, and the forging operation itself is a relative efficient and economical one.

The other forging operation, the die for which is illustrated, also provides a simple, but effective, means of forging the replacement half balls for locomotive trailer yokes. These half balls, or bearing points, on the trailer journal boxes are originally cast integral with the yokes, but become worn in service and require replacement by welding on new forged steel half balls of the required shape. In shops where large capacity turret lathes are not available for machining the half balls, they can each be forged in a single operation using a die of the type illustrated.

This main die, also made of axle steel, is recessed as shown and provided with a hole in the bottom and a plug ½ in. shorter than the hole. The smaller portion of the die is recessed to form the hemispherical portion of the forging. The stock used consists of 8-lb., 3½-in. round steel, the blanks being approximately 4 in. long. They are heated to a temperature of 2,000 deg. in the furnace and are then ready for forging. Each blank, after being heated, is placed in the main die supported vertically on the anvil under the steam hammer, and the smaller die with the hemispherical recess is placed in an inverted position in the main die, resting on the heated blank. Operation of the steam hammer then forces the metal into the dies with a ½-in. collar on the flat side, as shown at the left in the illustration. On removal of the upper die block and tipping up the main die, a light hammer blow on the plug is usually sufficient to release the forging, which has been quickly, economically and accurately made.

Automobile Type Spring Used on Locomotives

So much trouble was being experienced by one of the northern railroads with spring breakage, both in the leaves and in the bands of springs used on Pacific



Preliminary tests of this spring have indicated improved service

type engines, that it was decided to do some experimenting with the automobile type spring, such as used on heavy motor trucks.

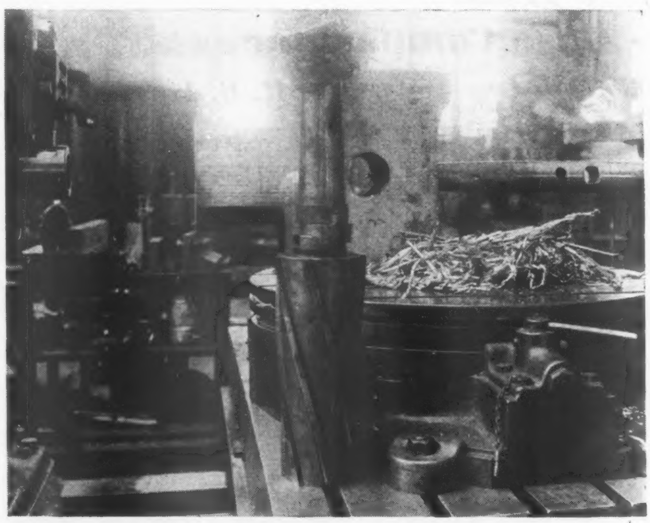
Instead of using the conventional band to bind the leaves together at the center, each spring leaf was drilled and a ⅞-in. hardened steel bolt was inserted through the center, as shown in the illustration. Two U-clamps were also applied to keep the leaves from side slippage.

Several of the Pacific type passenger locomotives were equipped with these springs in December, 1932, and as yet have given no trouble. It was felt that changes in temperature resulting in the spring bands becoming frosted during extremely low temperatures contributed to band breakage, but tests will be made to determine definitely whether the same causes will have any undesirable effect on the center bolt.

The leaves used in both springs are interchangeable, except for the drilling of the hole in the center of each leaf.

Floating Reamer

In refinishing piston-rod fits in crossheads the floating reamer illustrated has been used to good advantage at the Battle Creek (Mich.) shops of the Grank Trunk Western. For this, and other similar operations, the work must be centered with great accuracy on the boring-mill table when using a solid-shank reamer, or else the



High-speed steel inserted-blade taper reamer which is self-alining—The knurled sleeve removed to show the construction of the floating Morse Taper shank

reamer chatters and this makes the reaming of a smooth hole practically impossible. With a floating reamer, however, it is not necessary to spend so much time and care in lining up the crosshead on the table as the reamer will follow the general direction of the original bore, the floating shank providing sufficient flexibility to accommodate any slight inaccuracy in alinement of the crosshead center with the center line of the boring-mill spindle.

Referring to the illustration, the floating shank construction will be evident. It consists of a No. 5 Morse taper shank, driving the reamer through an intermediate cylindrical block provided with two square tongues at right angles to each other, one on the top face of the block and one on the bottom face. These tongues fit in corresponding grooves in the taper shank and in the reamer top. A knurled sleeve slips down over the parts to hold them in the proper relation and still allow a small amount of lateral play, this sleeve being firmly screwed onto threads on the reamer body. The reamer itself is made with inserted blades of high-speed steel and it produces the type of chips shown at the right on the boring-mill table.

Vise and Flexible Joints

*By A. Skinner**

THE design of flexible metallic pipe connections between engine and tender, or passenger-train cars, is such that they cannot be readily held in a ordinary vise while being dismantled and repaired. To facilitate

Special vise jaws for use in repairing flexible metallic pipe joints

this work, a bench vise can he equipped with special removable jaws, as shown in the illustration. Two adaptor blocks are fitted to the original vise jaws, as illustrated, provided with grooves 5/8 in. wide by 3/4 in. deep to accommodate the special holding jaws. These diamond-shaped jaws are made of 5/8-in. by 2 5/8-in. by 6-in. steel blocks machined to the shape shown and provided with teeth cut on the face of the holding surfaces to give a secure grip on the flexible joints. These jaws, which are held in the adaptors by suitable pins, are hardened and tempered to give added durability.

This makes an ideal vise arrangement for use in repairing flexible joints or for removing broken pipe and pipe fittings; also for other jobs which frequently must be done in which an ordinary vise will not give the proper grip. The special vise jaws, illustrated, are inexpensive to make and satisfactory material can usually be found around the shop or saved from scrap material.

* General foreman, Atchison, Topeka & Santa Fe, Corwith (Chicago), Ill.

Two New Lubricating Pastes

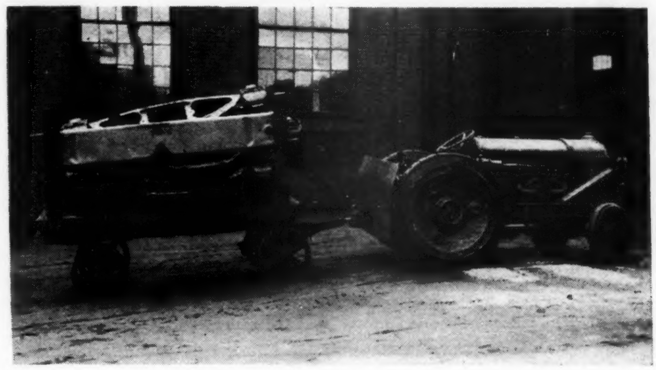
PROPER and regular lubrication of packings is essential to successful operation. Insufficient lubrication, or the use of the wrong kind of lubricant, results in excessive friction, scored rods, leaks and the ultimate destruction of the packing.

To provide packing users with correct lubricants for packings the Garlock Packing Company, Palmyra, N. Y., has developed Garlock lubricating paste compound No. 2 for steam and water packings and Garlock lubricating paste compound No. 3 for packings working against gasoline and oils. These pastes are intended to replace the hand-mixed lubricating compounds frequently used for this purpose. When applied to packings at regular intervals friction is reduced, maximum efficiency obtained, and the life of the packings in service prolonged.

Garlock lubricating pastes are packaged in standard 12-oz., 24-oz., and 5-lb. cans. They are also furnished in larger special containers of any size.

Protection for Motor-Truck Operators

THE tractor shown in the illustration has been equipped with a protection plate behind the operator's seat to prevent injury to the operator should a piece of material fall from the trailer. Just such an accident



The plate on the tractor protects the operator from injury

to an employee was responsible for the adoption of this safety feature on one railroad.

The plate is made from 1/4-in. material which is reinforced on the inside by two pieces of 1 1/4-in. by 5-in. bar iron. This is riveted to the plate and also formed at the other end around the axle casing of the tractor.

A Handy Sketching Aid

THE necessity of making freehand sketches often arises when one is away from the drawing room and not in possession of any tools for this work. On such occasions one invariably has but little to work with

Using a key-ring identification tag as a sketching tool

aside from a pencil and a piece of doubled paper for a rough straight-edge. With no compass or curve for other lines, a key-ring identification tag or plate can be

used to make many curved lines. The plate, due to its shape, can be used as a small irregular curve. In addition, two different sized and almost perfect circles can be outlined. It is also convenient for fillets and half circles representing rivets. Gear teeth can be outlined presentably. When forced to do a bit of sketch work with but few tools handy, the above will help nicely over some of the usual difficulties.

Measuring Driving Wheel Laterals*

By F. B. Shafer†

WHILE the primary purpose in repairing locomotives is to place the entire locomotive, as a unit in first class mechanical condition, it is also highly desirable and economical to bring back to standard dimensions and tolerances each component part. Among some

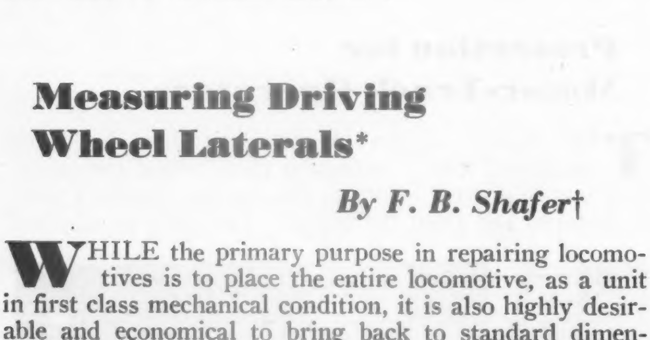


Fig. 1—Gage for measuring main frame in determining the proper lateral

of the major locomotive parts brought back to standard dimensions in the course of repairs are main frames. These frames wear where the shoe and wedge flanges bear against the frame legs, and repairs consist of building up the worn places by the electric-welding process and of machining them to standard dimensions.

In order to establish the proper lateral between the driving wheel hub liners and the driving box flanges against which contact is made, definite measurements must be made. The distance across the frames, the thickness of the shoe and wedge flanges, the thickness of

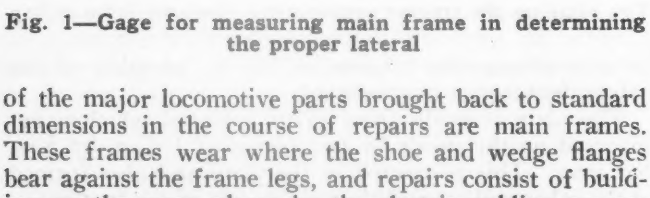


Fig. 2—Gage for checking lateral after the driving boxes are in position

the driving box flanges, and the distance between the hubs, must be computed. To accurately and quickly determine the adjustments necessary to establish the proper driving wheel lateral two gages were developed.

The first step in obtaining the correct lateral is to measure across the repaired pedestal legs of the main frames from outside to outside, utilizing the gage shown in Fig. 1. For example, suppose this dimension is 47 in.

* Reprinted by courtesy of N. & W. Magazine.
† Assistant foreman, Norfolk & Western, Roanoke, Va.

The shoe and wedge flanges are then measured and are found in this case to be ⅞ in. A lateral of ¼ in. is desired and all of these dimensions are totaled up below:

Distance across frames	47 in.
Shoe and wedge flanges (add both sides)	1¾ in.
Lateral desired	¼ in.
Total	49 in.

Then the driving wheels are gaged between the hubs and this dimension is found to be 53 in., in this case. The total dimension of 49 in. is then subtracted from the 53 in., the distance between the hubs, leaving 4 in., which is the thickness of both outside driving box flanges. Dividing the 4 in. by 2 gives 2 in., the proper driving box flange thickness to give the desired ¼ in. lateral.

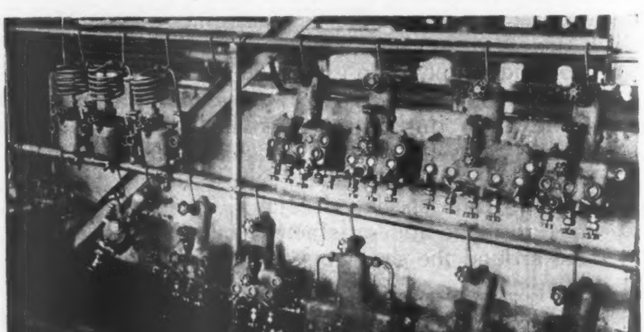
After the driving boxes have been machined, they are then placed on the journals with the flanges against the hub liners of each wheel, and the lateral is again checked, using the gage shown in Fig. 2. The gaging is done between the inside faces of the two outside driving box flanges. For the dimensions stated above, this second check should show 49 inches if all machine work has been correctly performed. If any error has been made in machine work, it will be found in the second check.

It has been found that these two gages not only save time in repairing locomotives, but they also insure an accurately determined lateral, which is imperative for satisfactory service.

Storage Rack For Lubricators

WHILE locomotives are in the back shop or enginehouse for repairs the lubricators are removed for cleaning, repair and test. Unless some definite arrangement is made to provide a specific place to store them until they are re-applied, they are liable to become damaged.

A satisfactory method of storing lubricators is shown



Lubricators stored in this manner are not easily damaged

in the accompanying photograph. This storage rack is made from 1¼-in. black iron pipe and is not only inexpensive, but also requires a minimum of space in the shop because of the fact that it can be built against a wall, beneath shop windows, or in any place not suitable for work benches or machines.

Because of the many small valves, tubes, plugs, etc., the more commonly used lubricators must be handled carefully to prevent damage to any of the above parts and must, therefore, be stored separately.

Among the Clubs and Associations

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The second National Lubrication Engineering meeting of the A. S. M. E. is to be held at the Pennsylvania State College, May 25-26, under the joint auspices of the college and the Lubrication Engineering Committee of the Petroleum Division.

Internal-Combustion-Type Motor Cars

Western Railway Club.—Meeting held Monday evening, April 17, at the Hotel Sherman, Chicago. Subject "Recent Developments of Internal-Combustion-Type Motor Cars," by E. Wanamaker, electrical engineer, Chicago, Rock Island & Pacific, Chicago. ¶ Starting with the statement that the invention and development of the internal-combustion engine have probably done more to change methods of transportation than any other discovery or invention, Mr. Wanamaker outlined some of the difficulties which, presenting greater obstacles in this than in other fields, have had to be overcome. These difficulties have been (1) the necessity for unusually light weight per unit of power output, together with ruggedness, simplicity and reliability; and (2) the fact that in railway service the power unit is operated by one set of men and maintained by another. In other words, in railway service, the operators of the power unit are not responsible for the net results obtained to the degree that they are in most other services where internal-combustion engines of comparatively large sizes are used. ¶ Maintaining that internal-combustion-type motors have not yet been designed for maximum adaptability in the railway field, Mr. Wanamaker said that recent developments have, in most cases, been along lines so conventional as to preclude the probability of being able to build power plants of sufficiently low cost, simplicity and ruggedness, such as are necessary to meet the conditions with which the railways are now confronted and will be for some time to come. ¶ Mr. Wanamaker called attention to the difference between steam locomotive maintenance and similar work on rail motor equipment. In the former, the mechanics know just about what to do from long experience, whereas in the latter, the maintainers must be not only skillful craftsmen, acquainted with the maintenance of gas or oil-electric motive power, but they must have more than ordinary initiative, resourcefulness and an understanding of the principles involved in more or less complicated equipment. ¶ Mr. Wanamaker commented on the characteristics of various types of internal-combustion motors and closed his paper with the following remarks regarding future possibilities: "The internal-combustion engine that would be most admirable for rail service would be one that is low in first cost, low in maintenance, low in operating cost, low in weight, small in size per unit of power output, and high in percentage as regards availability, service and long life. Such an engine should burn a low and inexpensive grade of fuel with freedom from fire hazards and offensive odors or fumes. ¶ "There is but little doubt but what most engineers and builders will say that such an engine cannot be built and in so far as reciprocating design is concerned, they may probably be right. It would, however, be well to remember that there are possibilities in a rotary design of oil or Diesel engine, especially so in sizes of from say approximately 400 to 1,500 hp. output, for the reason that the inter-relationship between volumetric displacement speed, velocities, weight and balancing seems to be better in the smaller or larger sizes than in those just mentioned. ¶ "If such a rotary engine were built, it would make possible the development of a light-weight, high-speed electric generator, probably with a high frequency and potential, with small light-weight traction motors to correspond with a simple and efficient control."

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal Building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—Division V. —MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I.—SAFETY SECTION.—J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS. —Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church street, New York.

MACHINE SHOP PRACTICE DIVISION.—R. E. W. Harrison, 6373 Beechmont avenue, Mt. Washington, Cincinnati, Ohio.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—Edgar J. Kates, 1350 Broadway, New York.

FUELS DIVISION.—W. G. Christy, Department of Health Regulation, Court House, Jersey City, N. J.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid avenue, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce street, Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

CANADIAN RAILWAY CLUB.—C. R. Crook, 2276 Wilson avenue, Montreal, Que. Regular meetings, second Monday of each month except in June, July and August at Windsor Hotel, Montreal, Que.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—G. K. Oliver, 2514 West Fifty-fifth street, Chicago. Regular meetings, second Monday in each month except June, July and August, Auditorium Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth street, Council Bluffs, Iowa. Regular meetings, second Thursday of each month at Council Bluffs.

CENTRAL RAILWAY CLUB OF BUFFALO.—M. D. Reed, Room 1817, Hotel Statler, Buffalo, N. Y. Regular meeting, second Thursday each month, except June, July and August, at Hotel Statler, Buffalo.

CLEVELAND RAILWAY CLUB.—F. B. Frericks, 14416 Alder avenue, Cleveland, Ohio. Meeting second Monday each month, except June, July and August, at the Auditorium Hotel, East Sixth and St. Clair avenue, Cleveland.

EASTERN CAR FOREMEN'S ASSOCIATION.—E. L. Brown, care of the Baltimore & Ohio, Staten Island, N. Y. Regular meetings, fourth Friday of each month, except June, July, August and September.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—R. A. Singleton, 822 Big Four building, Indianapolis, Ind. Regular meetings first Monday of each month, except July, August and September, at Hotel Severin, Indianapolis, at 7 p. m. Noon-day luncheon, 12:15 p. m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—T. D. Smith, 1660 Old Colony building, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha street, Winona, Minn.

MASTER BOILERMAKER'S ASSOCIATION.—A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

NATIONAL SAFETY COUNCIL—STEAM RAILROAD SECTION.—W. A. Booth, Canadian National, Montreal, Que.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic avenue, Boston, Mass. Regular meeting, second Tuesday in each month, excepting June, July, August and September, Hotel Statler, Boston.

NEW YORK RAILROAD CLUB.—D. W. Pye, Room 527, 30 Church street, New York. Meetings, third Friday in each month, except June, July and August, at 29 West Thirty-ninth street, New York.

NORTHWEST CAR MEN'S ASSOCIATION.—E. N. Myers, chief interchange inspector, Minnesota Transfer Railway, St. Paul, Minn. Meeting first Monday each month, except June, July and August, at Minnesota Transfer Y. M. C. A. Gymnasium building, St. Paul.

PACIFIC RAILWAY CLUB.—W. S. Wollner, P. O. Box 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN. —C. L. Roberts, R. F. D. 5, Peoria, Ill.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August, Ft. Pitt Hotel, Pittsburgh, Pa.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION. —J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, July, September and November. Annual meeting, third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION.—E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TORONTO RAILWAY CLUB.—N. A. Walford, district supervisor car service, Canadian National, Toronto, Ont. Meetings first Friday of each month except June, July and August.

TRAVELING ENGINEER'S ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

WESTERN RAILWAY CLUB.—J. H. Nash, 1101 Peoples Gas building, Chicago. Regular meetings third Monday in each month except June, July, August and September.

NEWS

The American Refrigerator Transit Company, owned jointly by the Missouri Pacific and the Wabash, will spend $1,500,000 immediately for the reconstruction, repair and improvement of 1,300 refrigerator cars. About 75 per cent of the work will be done in the company's shops at St. Louis, 15 per cent at Kansas City, and 10 per cent at Pueblo. The work involves the application of high-speed wheels, trucks, springs and brakes, heavier metal roofs, modern ice boxes, additional insulation and modern water-proof floors. Orders have been placed with the Scullin Steel Company and the American Steel Foundries for 500 integral type cast steel side frames. The new side frames are to be used in combination with "Coil-Elliptic" spring groups.

Scholarship at Stevens Institute of Technology

The Mechanical Division, American Railway Association, has a scholarship at Stevens Institute of Technology vacant this coming September. This scholarship is available for the sons of members of the Mechanical Division and the course leads to the degree of mechanical engineer. The course offered also includes instruction in electrical, civil and other branches of engineering.

C. & O. Through Trains To Be Air-Conditioned

All through passenger trains of the Chesapeake & Ohio will be air-conditioned by June 1 when the C. & O., an announcement states, will have become "the first and only railroad in the world to be 100 per cent air-conditioned in through main line passenger service." This program for modernizing passenger train equipment is announced in an article appearing in the May issue of "The Rail," the magazine published monthly by the C. & O. and the Pere Marquette.

"The outstanding success of the 'George Washington' during its first year's operation," the article says, "indicated clearly that the traveling public responded readily and generously to a program which made railroad travel clean and comfortable, cool in summer and refreshing in winter. That was the determining factor in the management's decision to go further and equip every through train with air-conditioning cars."

The air-conditioning system of the Pullman Car & Manufacturing Corporation will be used; this it is stated, is designed for all-season operation, not merely for cooling or conditioning during hot weather.

The Chesapeake & Ohio, as reported in the April *Railway Mechanical Engineer*, placed an order with the Pullman Car & Manufacturing Corporation for the installation of air-conditioning equipment in six passenger cars, including one lounge-dining car, two club dining cars, one salon coach and two dining cars (tavern). The air-conditioning of these cars was followed by the installation of air-conditioning equipment in 25 Pullman cars for operation in the same trains. Through trains may possibly be equipped before June 1.

Among the trains which, in addition to the "George Washington" will comprise the C. & O.'s air-conditioned fleet will be the "F. F. V." and the "Sportsman." All the cars of the "F. F. V." and of the "Sportsman" will bear names historically associated with "the development of the Chesapeake & Ohio into a great trunk line system and with the historic territory it serves." The cars of the "George Washington" are named for places, persons and events connected with the life and works of the first President.

Passenger Exchange Rule 10 Eliminated

Circular No. D.11-387, issued by G. W. Covert, secretary, Transportation Division, American Railway Association, 59 E. Van Buren street, Chicago, covers a revision of Car Service Rule 8, whereby the charge for the use of electric lighting equipment is combined with the rental rates of passenger-train cars under that rule. Passenger Rule 10 has, therefore, been eliminated from the Code of Interchange Rules of the A. R. A., Mechanical Division, according to a letter recently issued by V. R. Hawthorne, secretary. These changes in rules were made effective April 1, 1933.

Shop Employment

The Missouri Pacific during April recalled a total of 950 men to work in its shops at St. Louis, Mo., Kansas City, Sedalia, Poplar Bluff, Nevada; Little Rock, Ark.; Monroe, La.; Hoisington, Kan., and Coffeyville. Four hundred twenty-five men were employed at Little Rock and a similar number at Sedalia and worked 10 days during the month. The remaining 100 returned to steady employment on April 1 at the other locations.

The Missouri-Kansas-Texas reopened its shops at Parsons, Kan., Sedalia, Mo., and Waco, Tex., on April 1, thus affording employment for 780 mechanics for about three months. According to M. H. Cahill, chairman of the board and president, the Katy's maintenance program for this year will be much larger than last year and will provide considerable additional employment. Extra gangs are now relaying 20 miles of track with new 90-lb. rails south of McAlester.

The Great Northern opened its Spokane, Wash., shops on April 3, giving employment to 250 men. These shops had been closed for a month, except for a skeleton force.

The New York Central has recalled 300 men to work at its car shops in East Buffalo, N. Y.

Report of Bureau of Explosives

Colonel B. W. Dunn, chief inspector of the Bureau for the safe transportation of explosives and other dangerous articles, in his annual report for the calendar year 1932, recently issued from his office, 30 Vesey Street, New York City, says that all dangerous explosives offered the railroads in the United States and Canada during the year were transported with a safety record of 100 per cent; no deaths, no injuries and no property loss. The total quantity of explosives transported in 1932 was about 100,000 tons, which is two-thirds of the total for the year preceding and less than half the total for 1929. No loss of life has been reported in the handling of explosives on the railroads for the past eight years.

Including "other dangerous articles" the year 1932 showed 607 accidents, two persons killed and 19 injured; property loss $372,599.

Of the property loss in 1932, gasoline accounts for $339,186. The report contains the usual detailed tables, including the circumstances of the 17 gasoline tank-car fires included in the record.

The number of inspections of freight stations made by the bureau in 1932 was 5,690; boxes of high explosives condemned as unsafe, 980; cars in transit found showing serious violations of regulations, 22; cars inspected, containing dangerous articles other than explosives, 11,900.

(*Turn to next left-hand page*)

USE MODERN MATERIALS FOR ALL REPLACEMENTS

Most locomotives now in service lacked the benefit of modern materials when they were built 20 years or more ago. « But they, too, can have the longer wear and lower maintenance that come from modern materials. « When boiler tubes need replacement use tubes of Toncan Iron to obtain greater resistance to corrosion. « When staybolts are cut out replace them with Agathon alloy bolts. Alloy materials have higher strength, better shock resistance and greater resistance to corrosion. « So, too, with engine bolts, axles, pins and all wearing parts. Republic metallurgists have developed special railroad alloy steels and irons for specific purposes that will lower future maintenance costs. « Consult Republic on your materials problems.

Toncan Iron Boiler Tubes, Pipe, Plates, Culverts, Rivets, Staybolts, Tender Plates and Firebox Sheets • Sheets and Strip for special railroad purposes • Agathon Alloy Steels for Locomotive Parts • Agathon Engine Bolt Steel • Agathon Iron for pins and bushings • Agathon Staybolt Iron • Climax Steel Staybolts • Upson Bolts and Nuts • Track Material, Maney Guard Rail Assemblies • Enduro Stainless Steel for dining car equipment, for refrigeration cars and for firebox sheets • Agathon Nickel Forging Steel.

The Birdsboro Steel Foundry & Machine Company of Birdsboro, Penna. has manufactured and is prepared to supply, under license, Toncan Copper Molybdenum Iron castings for locomotives.

CENTRAL ALLOY DIVISION, MASSILLON, OHIO

AGATHON STEELS

REPUBLIC STEEL CORPORATION

GENERAL OFFICES — R — YOUNGSTOWN, OHIO

TONCAN IRON

Supply Trade Notes

THE P. & M. COMPANY has moved its New York City office to 165 Broadway.

THE BROWN & SHARPE MFG. COMPANY, Providence, R. I., is this year celebrating its one hundredth anniversary.

THE GENERAL OFFICES of the Railway Service & Supply Corporation, Indianapolis, Ind., were moved on April 1 and combined with the manufacturing and laboratory facilities at 510 South Harding street, Indianapolis.

JULIUS KINDERVATER has been appointed manager of the Alco plant of the American Locomotive Company, Richmond, Va., succeeding George Gurry, resigned. Mr. Kindervater will continue to handle matters pertaining to the office of mechanical superintendent.

CYRUS J. HOLLAND, formerly representative of the Wine Railway Appliance Company, has opened an office in the Peoples Gas building, Chicago, to engage in the sale of a combination helical-volute truck spring for railway cars.

CONRAD N. LAUER, president of the Philadelphia Gas Works, Philadelphia, Pa., and Robert C. Shields, of Detroit, Mich., who is connected with Fisher & Company, have been elected members of the board of directors of the Baldwin Locomotive Works, Philadelphia.

NEIL C. HURLEY, chairman of the executive committee of the Independent Pneumatic Tool Company, Chicago, has been elected president, to succeed R. S. Cooper, who has been appointed vice-president in charge of the eastern territory, with headquarters at New York.

H. B. SNYDER, who has been connected with the Pilliod Company, New York, for many years as assistant to the president, and for the past two years stationed at the factory, Swanton, Ohio, in charge of engineering, has resigned. L. R. Baker has been appointed mechanical engineer with office at the Swanton works.

LUCIEN Q. MOFFITT, INC., People's Bank building, Akron, Ohio, has been appointed exclusive distributor by the B. F. Goodrich Rubber Company, Akron, for its cutless rubber bearings in the United States and Canada. Lucien Q. Moffitt, who has been manager of the cutless rubber bearing department of the Goodrich Rubber Company since this new bearing was placed on the market several years ago, heads the new distributor company. With him are associated the same engineering and sales personnel which handled these bearings in the Goodrich office.

GEORGE A. NICOL, JR., vice-president in charge of transportation and government sales for the Johns-Manville Sales Corporation, New York, has been appointed an executive vice-president. In addition to his responsibilities on transportation and government sales, Mr. Nicol assumes direction of the company's automotive sales, including the equipment, replacement and private-brand sections and direction of sales filtration and filler materials. John H. Trent has been appointed general sales manager of transportation and government sales. J. T. Spicer is general sales manager of the automotive department and A. S. Elsenbast general sales manager of filters and filler sales.

George A. Nicol, Jr., was born at Providence, R. I., and after attending Mount Pleasant Academy, English High School and Rhode Island School of Design, served a special apprenticeship at the Rhode Island Locomotive Works. Subsequently he was a locomotive designer with the American Locomotive Company until March, 1904, when he went to the Louisville & Nashville as locomotive designer. He later specialized in car design. From August, 1905, to 1909, he was with the Baltimore & Ohio as designing engineer in

George A. Nicol, Jr.

the mechanical department at Baltimore, Md. He then became railroad representative of the H. W. Johns-Manville Company, which later became the Johns-Manville Corporation. Two years later he was transferred to the executive headquarters at New York as eastern assistant manager of its railroad department. In 1920 he was promoted to the position of eastern manager of that department and in 1924 was appointed general manager of the railroad and government departments, as well as a director of the company. Mr. Nicol, who has served since 1928 as a vice-president, now becomes an executive vice-president of the Johns-Manville Sales Corporation.

John H. Trent was born in Meade county, Ky., and was educated in the public schools of Paducah, Ky. In 1901 he entered the service of the Illinois Central and after serving in the mechanical and stores departments at Burnside shops, Chicago, became storekeeper at Water Valley, Miss., subsequently serving at Memphis, Tenn., and Paducah. Mr. Trent, who has been for over 25 years in the service of the Johns-Manville Sales Corporation and its predecessors, had been serving as general sales manager of the western region, with headquarters at Chicago, at the time of his

John H. Trent

appointment as general sales manager of transportation and government sales.

C. S. CLINGMAN has been appointed sales manager of the western region, transportation and government department, of the Johns-Manville Sales Corporation with headquar ers at Chicago, succeeding John H. Trent, promoted. Mr. Clingman was educated at Northwestern University having taken a mechanical engineering course in 1904. He began work with the Pullman Company in its apprentice school and was promoted in 1907 to assistant general shop foreman at the Pullman, Ill., works. The following year has was transferred to Wilmington, Del., as eastern mechanical inspector. In 1910 he returned to the Pullman Manufacturing Company and Pullman works as mechanical inspector and the following year was promoted to general mechanical inspector with office at Chicago. Mr. Clingman entered the service of Johns-Manville in 1917 as a sales engineer in the southwest and for the past year has been serving as manager of the southwestern division with headquarters at St. Louis, Mo. A. C. Pickett has been appointed manager of the southwestern division of the transportation and government department, with headquarters at St. Louis.

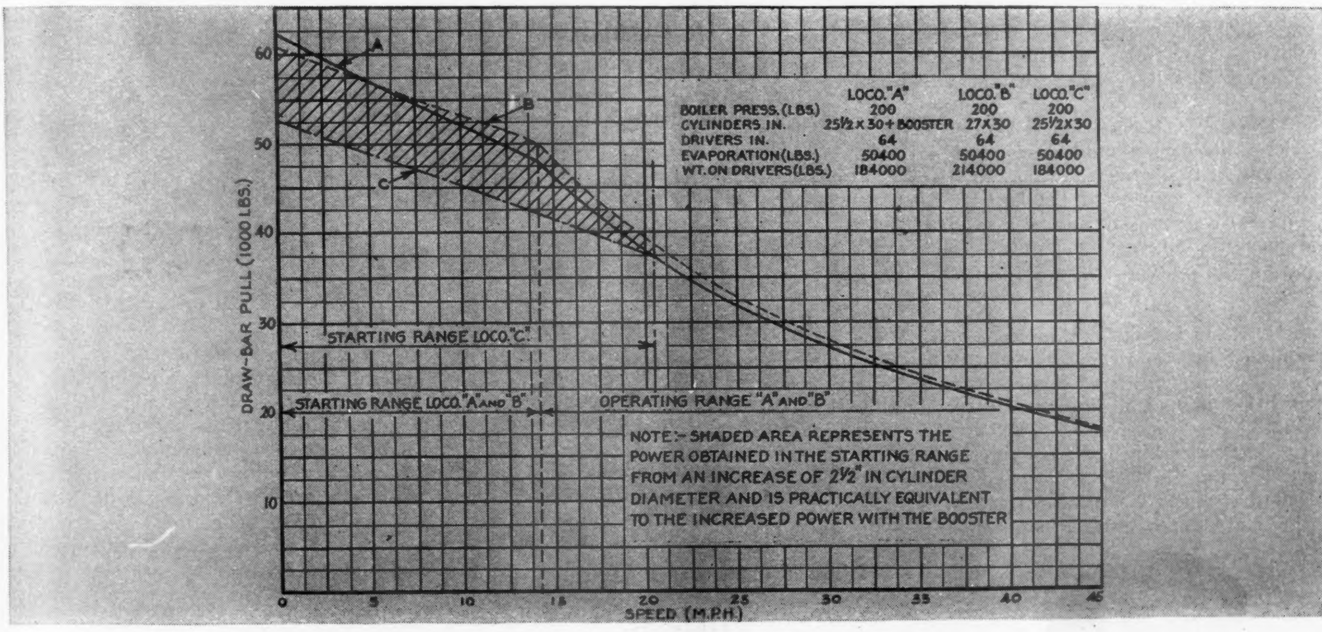
Obituary

J. F. SATTLEY, sales representative for the Chicago district of the Winton Engine Corporation, which recently absorbed the Electro-Motive Company, died in Chicago on April 7 following an operation.

LEWIS OLIVER CAMERON, who had been engaged for a number of years in the railway supply business and as representative of railway supply manufacturers, with headquarters at Washington, D. C., died at his home in that city on April 13 after a lingering illness. Mr. Cameron was born on April 17, 1868, at Pittsburgh, Pa., and began his active business life in the railroad supply industry. He was southern sales representative of the Pressed Steel Car Company, at Washington, from 1905 to 1922 and of the Edgewater Steel Company from 1919 to the time of his death. Among others he had represented was the Youngstown Steel Door Company.

(Turn to next left-hand page)

This Flexible POWER COMBINATION Means *Lower* Maintenance



THERE is a maintenance advantage to incorporating The Locomotive Booster as an integral part of the locomotive.

Maintenance is roughly proportional to the work done. Without The Locomotive Booster larger cylinders must be used to get the power required. But when that maximum demand lessens, the large cylinders must still be used to get the train over the road.

Contrast this with a design embodying smaller cylinders plus The Locomotive Booster to secure the desired maximum tractive effort. If The Locomotive Booster were worked continuously there would be no maintenance economy. But except at peak load The Locomotive Booster is inoperative and the smaller cylinders do the work. Since less work is done, maintenance is lowered.

In addition, the combination of smaller cylinders and The Locomotive Booster reduces the weight of the main engine by 25,000 lbs. or more—another important economy.

FRANKLIN RAILWAY SUPPLY COMPANY, INC.

NEW YORK CHICAGO MONTREAL

Personal Mention

General

G. E. Passage, division master mechanic of the Chicago, Milwaukee, St. Paul & Pacific, has been appointed trainmaster and traveling engineer with headquarters at Terre Haute, Ind.

W. G. Black has been appointed vice-president of the Chesapeake & Ohio, the New York, Chicago & St. Louis and the Pere Marquette, supervising purchases and stores and performing such other duties as he has heretofore performed for the president. Mr. Black, as assistant vice-president of the Chesapeake & Ohio and the Pere Marquette, had jurisdiction over the purchases and stores and mechanical departments of the former and the purchases and stores department of the latter. His jurisdiction had only recently been extended to include the purchases and stores department of the New York, Chicago & St. Louis.

John Roberts has been appointed chief of motive power and car equipment of the Canadian National, with headquarters at Montreal, Que., succeeding the late C. E. Brooks. Mr. Roberts was born at Kilmarnock, Scotland, in 1881, and entered the service of the C. N. R. as a machinist in the motive power shops at Stratford in 1903. He became charge hand there in

John Roberts

1907; foreman of the machine shop in 1917, and general foreman in 1920. In 1921, Mr. Roberts became acting superintendent. Later in the same year his appointment as superintendent of the Stratford shops was confirmed and he continued in that position until his appointment as general supervisor of shop methods for the system in 1923, with headquarters at Montreal, Que. On August 1, 1932, Mr. Roberts was appointed general superintendent of motive power and car equipment for the Central region, at Toronto, Ont., the position he held until his recent promotion.

Master Mechanics and Road Foreman

A. M. Martinson, assistant master mechanic of the Chicago, Milwaukee, St. Paul & Pacific, has been transferred to the Hastings & Dakota division, with headquarters at Aberdeen, S. D.

W. W. Bates has been appointed assistant master mechanic of the Milwaukee terminal and District No. 1 of the Milwaukee division of the Chicago, Milwaukee, St. Paul & Pacific, with headquarters at Milwaukee, Wis.

Car Department

W. M. Wheatley has been appointed general car inspector of the Chesapeake & Ohio, with headquarters at Columbus, Ohio.

William Lee, assistant general car foreman of the Union Pacific at Kansas City, Kan., has been promoted to the position of general car foreman, with headquarters at North Platee, Neb.

Purchasing and Stores

G. R. Williams, purchasing agent of the Spokane, Portland & Seattle, has had his headquarters moved from Portland, Ore., to Vancouver, Wash.

H. K. T. Sherwood, industrial agent of the Delaware & Hudson, has been appointed purchasing agent with headquarters at Albany, N. Y., succeeding H. A. Empie, deceased.

Obituary

Homer A. Empie, purchasing agent of the Delaware & Hudson, with headquarters at Albany, N. Y., died on February 20.

Andrew Riley, purchasing agent of the New York, Ontario & Western, with headquarters at New York, died on April 2, at his home in Edgewater, N. J.

C. E. Brooks, chief of motive power and car equipment of the Canadian National and prominent railway mechanical engineer, died at his home in Montreal, Que., on April 10, after a short illness. Mr. Brooks was 46 years old. He was president of the Canadian Railway Club in 1924-25. He was a member of the General Committee of the Mechanical Division, A. R. A., and also a member of the Committee on Locomotive Design and Construction. For the past five years he served as a member of the General Committee of the Railroad Division of the American Society of Mechanical Engineers. As chief of motive power of the Canadian National, Mr. Brooks became widely-known for his work in developing special types of motive power equipment, including Diesel locomotives. He was born July 3, 1886, at Constantinople, Turkey, where his parents served as missionaries for 16 years. His grandfather was one of the founders of the Grand Trunk Railway and its first vice-president. Mr. Brooks received his higher education at McGill University, Montreal, from which he was graduated in 1908 with an A.B.S. degree. His vacations from school were spent working in various positions, including those of apprentice and fireman on the Grand Trunk at Montreal. Becoming a machinist after his graduation from McGill, Mr. Brooks went to western Canada and, in the employ of the Grand Trunk Pacific, worked as locomo-

C. E. Brooks

tive foreman, machinist and shop foreman, general foreman and superintendent of motive power at Rivers and Portage la Prairie, Man.; Watrous and Regina, Sask.; Wainwright and Edmonton, Alta.; and Transcona (Winnipeg) Man. In 1920 he was appointed mechanical assistant (locomotives) to the operating vice-president, Canadian National, at Toronto, and in 1923 he was transferred to Montreal as chief of motive power for the Canadian National System. Mr. Brooks also took over car equipment services in 1932.

Trade Publications

Copies of trade publications described in the column can be obtained by writing to the manufacturers. State the name and number of the bulletin or catalog desired, when mentioned in the description.

"Using Paint as Light."—This is the title of a booklet issued by the New Jersey Zinc Company, 160 Front street, New York, which is "An A. B. C. summary of 'The Influence of the Reflecting Characteristics of Wall Paints upon the Intensity and Distribution of Artificial and Natural Illumination,' by D. L. Gamble, Research Division of the New Jersey Zinc Company."

Bronze Welding Rod—The Linde Air Products Company, 205 East Forty-Second street, New York, describes in a 20-page booklet the physical and welding characteristics of the new Oxweld No. 25 M. bronze patented welding rod. Recommendations on a new technique for bronze welding and for the fusion welding of brasses and bronzes are given and the proper flame adjustments described for the various base metals.